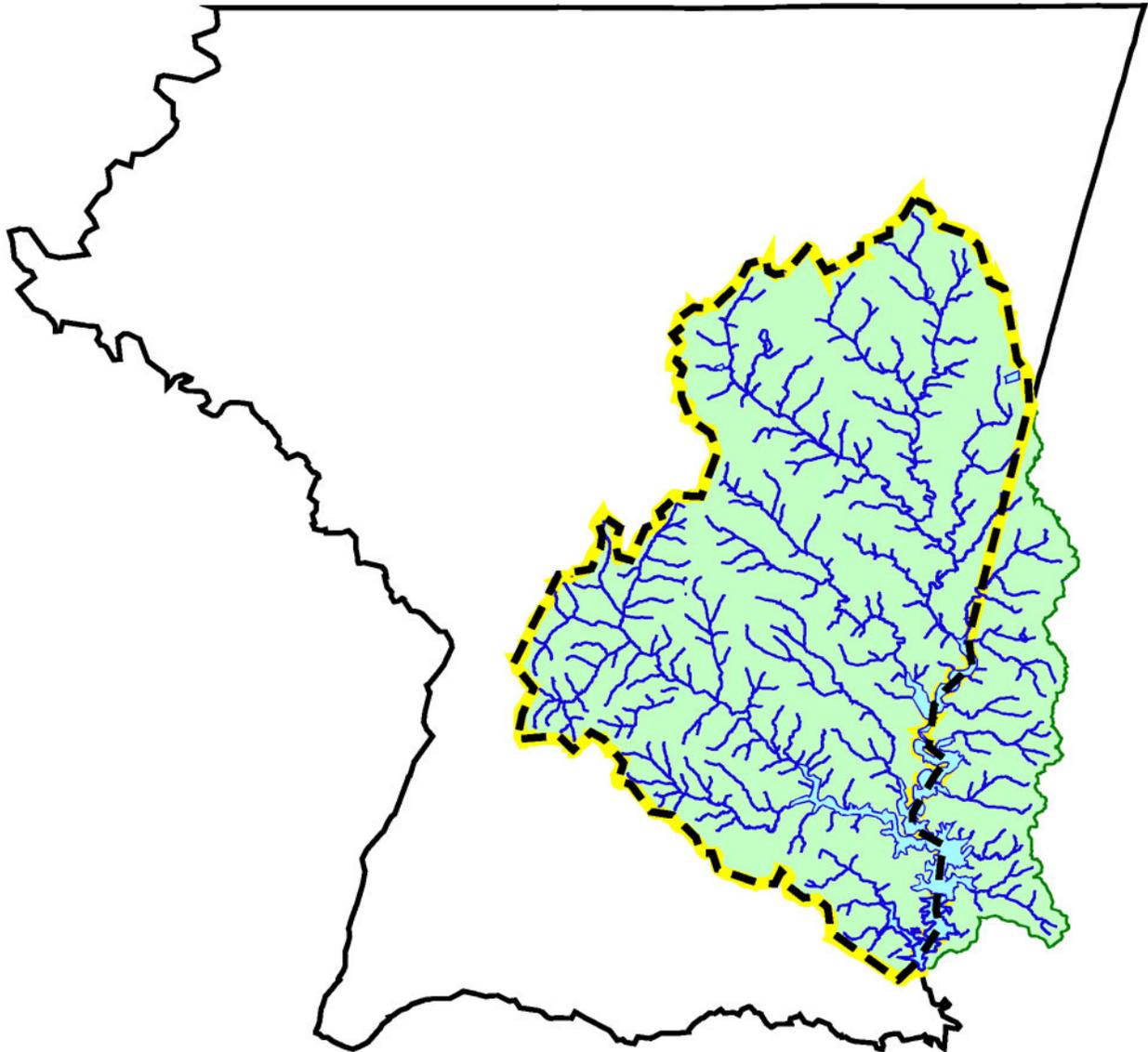


Liberty Reservoir Watershed Restoration Action Strategy Within Carroll County, Maryland

Final Report
March 2003



Carroll County
Department of Planning
Bureau of Resource Management

A Watershed Restoration Action Strategy for the Liberty Reservoir Watershed within Carroll County Maryland

A Procedure Established to Assess Watershed Conditions
and Direct Future Watershed Restoration and Protection
Measures

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Summary

Protecting the drinking water quality of Liberty Reservoir is an important goal for Carroll County and the rest of the Baltimore Metropolitan Area. In order to protect this drinking water resource, steps have been taken to address problems within the land area draining to the Liberty Reservoir. The State of Maryland, through the Unified Watershed Assessment process, deemed Liberty Reservoir the highest priority in need of both protection and restoration. Funding was then made available to Carroll County to implement a Watershed Restoration Action Strategy (WRAS) that addresses impairments within the Liberty Reservoir Watershed and proposes solutions to those impairments.

The goal of this project was *to develop a Watershed Restoration Action Strategy for selected subwatersheds designed to maintain and enhance the water quality of streams draining to Liberty Reservoir. It will be based on a characterization of the Liberty Reservoir Watershed within Carroll County, and an assessment of stream corridors for the selected subwatersheds.*

With the assistance from partner agencies, the Carroll County Water Resource Planning Division 1) developed a procedure to assess a watershed's condition, 2) identified threats in that watershed that reduce the drinking water quality of Liberty Reservoir, 3) prioritized those subwatersheds, and 4) targeted subwatersheds to implement action strategies designed to improve stream conditions and water quality.

The Water Resource Planning Division selected two watersheds to test the watershed evaluation procedure: Middle Run and Snowdens Run. Watershed assessments involved gathering and updating watershed-related information, creating new data layers of information that did not exist previously, and working cooperatively with DNR staff to collect water quality information within the selected subwatersheds including visual assessments of stream corridors, nutrient levels, and biological monitoring information.

The seven action strategies developed to improve watershed conditions with the Middle Run and Snowdens Run watersheds and ultimately drinking water quality of Liberty Reservoir are listed below.

- Strategy 1: Nutrient Source Tracking Strategy
- Strategy 2: Agriculture Best Management Practice Targeting Strategy
- Strategy 3: Stormwater Retrofit/Storm Drain Repair Strategy
- Strategy 4: Stream Buffer Planting Strategy
- Strategy 5: Database Maintenance Strategy
- Strategy 6: Establish Watershed Advisory Committees
- Strategy 7: County Program Coordination Strategy

The watershed evaluation procedure established and refined during the grant period will enable Carroll County to target opportunities for improving watershed conditions in the future. It is important that this evaluation procedure be followed when adequate resources become available. Limited funding demands that a rigorous and defensible evaluation procedure be followed prior to implementing watershed restoration measures.

Acknowledgements

Carroll County's Water Resource Planning Division (WRPD) wishes to acknowledge the following partner agencies and groups involved during the creation of this Watershed Restoration Action Strategy.

1. The Department of Natural Resources, Watershed Restoration Division
2. The Reservoir Technical Group of the Baltimore Metropolitan Council
3. The Carroll County Soil Conservation District
4. The Friends of Carroll County Streams
5. Carroll County Department of Public Works

Many individuals contributed significantly to the success of this project. Without the assistance from Brenda Morgan, the grant coordinator, this project would not have been possible.

Thanks also to the Maryland Conservation Corps's Echo Lake Crew for conducting the stream corridor assessments and compiling the data. Thanks also to several members of the Carroll County Planning Department for enduring long and thorny days collecting stream corridor assessment information for the West Branch of the Patapsco.

Other County staff members that contributed to this project include: Jeff Keefer, Rose Mann, Tara Mayers, Nick Patterson, Stan Pennington, and Mike Roberts. Thanks also to Stan Sharkey for serving as an editor.

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Thanks also to Bill Stack, Benton Watson, and Martin Covington for helping to develop the action strategies.

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I. Introduction

This report is a culmination of a three-step process to establish a procedure to 1) identify impairments to the stream system within a watershed, 2) determine the likely causes to those impairments, and 3) propose opportunities for restoration and mitigation. The solutions, tailored to each watershed that is assessed and evaluated, can be interpreted as action strategies, or grouped together as a watershed management plan. Once established, this procedure will provide the foundation for future watershed assessment and restoration targeting efforts in Carroll County.

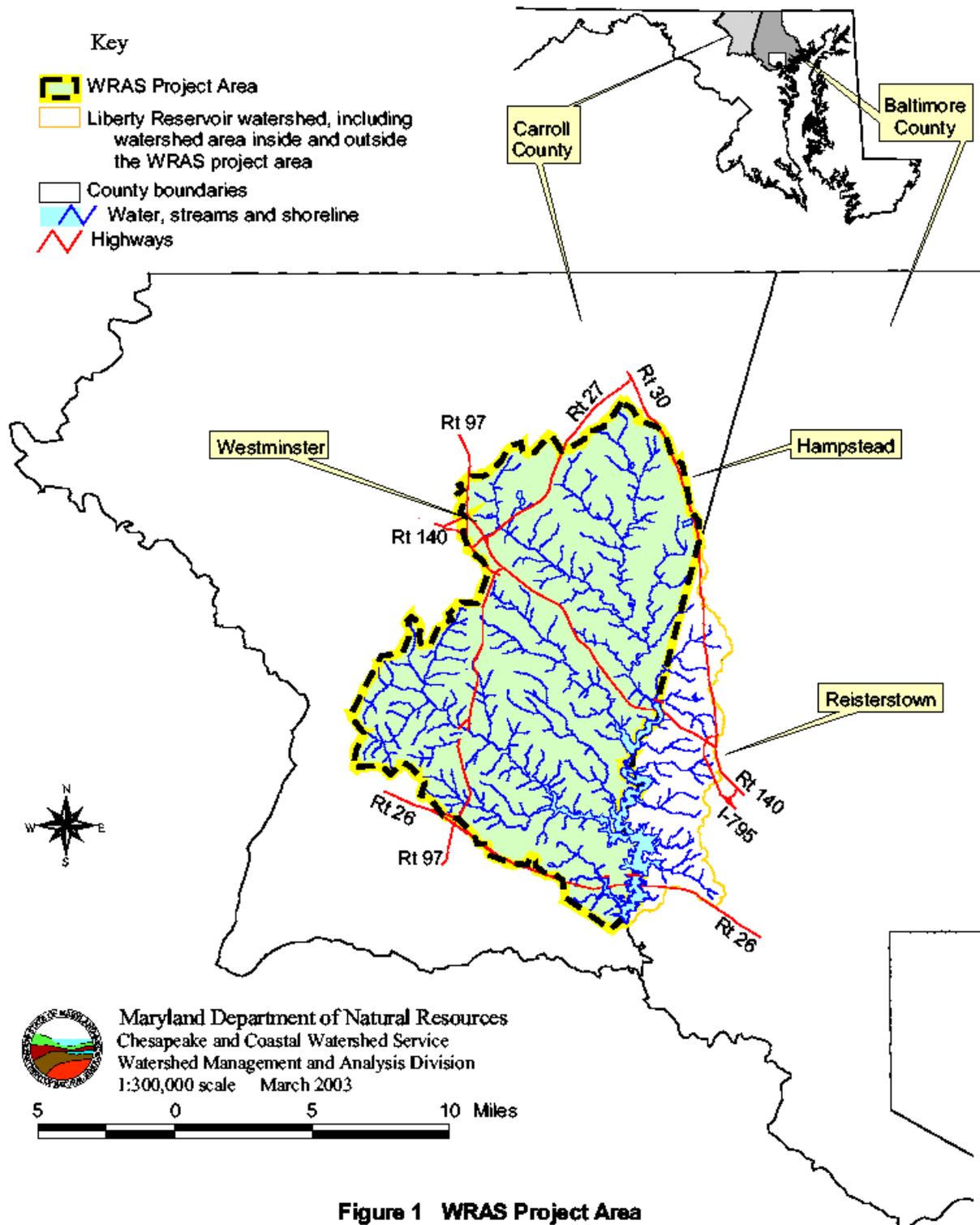
Carroll County, the City of Baltimore, and the State of Maryland all consider the Liberty Reservoir Watershed (figure 1) a high priority in need of protection primarily because of its use as a drinking water supply for the Baltimore Metropolitan area including five surrounding counties (Anne Arundel, Baltimore, Carroll, Harford, and Howard). In 1998, Maryland's Clean Water Action Plan identified watersheds across the state in need of protection and restoration. Initially, a Unified Watershed Assessment characterized the condition of Maryland's larger watersheds and classified each into the following categories:

- Category 1 - Watersheds not meeting clean water and other natural resource goals therefore needing restoration
- Category 2 - Watersheds currently meeting goals that need preventive action to sustain water quality and aquatic resources
- Category 3 - Pristine or sensitive watersheds that need an extra level of protection

As a result, Liberty Reservoir's watershed was classified as both a category 1 and 3; consequently, it is viewed in need of both restoration and an extra level of protection. After the Unified Watershed Assessment was completed, restoration priorities were assigned to each watershed. The Liberty Reservoir watershed received the highest priority for restoration and protection. Only 17 of the 138 larger watersheds (coded with 8-digits) in Maryland were ranked as highest priority for both restoration and protection. The last step of the Clean Water Action Plan was to develop action strategies that identify “the most important causes of water pollution and resource degradation, detail the actions that all parties need to take to solve those problems, and set milestones by which to measure progress” (Clean Water Action Plan Technical Workgroup, 1998). Funding was then made available to Carroll County to develop a Watershed Restoration Action Strategy.

The first step in the development of a Watershed Restoration Action Strategy (WRAS) for Liberty Reservoir was to characterize its watershed. The characterization provides analysis of existing information for the entire watershed of Liberty Reservoir. Staff from the Maryland Department of Natural Resources (DNR), with input from the Carroll County Water Resource Planning Division (WRPD), completed this characterization in September 2002. It summarizes relevant information related to the Liberty Reservoir Watershed. It also describes the condition of the watershed from many different perspectives (e.g., water quality, water supply, land use, living resources). Finally, it identifies sources for additional information and analysis. For further information, the Liberty Reservoir Watershed Characterization can be found on DNR's web site at www.dnr.state.md.us/watersheds/surf/proj/wras.html.

Liberty Reservoir Watershed Restoration Action Strategy



To develop action strategies, a detailed watershed assessment (at a smaller subwatershed scale) is necessary to identify the impairments and their probable causes. To accomplish this goal, WRPD with assistance of DNR, gathered watershed-related information, updated databases, and collected new information necessary to accurately assess the health or condition of the stream system within subwatersheds. County staff could not perform the detailed assessments necessary for the entire Liberty Reservoir Watershed during the one-year grant period; therefore, WRPD evaluated available water quality monitoring data from the City of Baltimore and selected two subwatersheds to initially investigate and focused on developing an assessment and evaluation procedure.

After the watershed assessments were completed, information gathered was combined and evaluated to identify opportunities to improve watershed conditions. WRPD accomplished this phase in two steps. First, WRPD identified likely causes to the stream impairments discovered during the assessment phase. Next, WRPD identified opportunities or *action strategies* within each selected subwatershed to address causes of watershed degradation and protect existing natural resources.

The goal of this project, as stated in the original scope, was *to develop a Watershed Restoration Action Strategy (WRAS) for selected subwatersheds designed to maintain and enhance the water quality of streams draining to Liberty Reservoir. It will be based on a characterization of the Liberty Reservoir Watershed within Carroll County, and an assessment of stream corridors for the selected subwatersheds.* A few of the objectives to accomplish this goal are included here:

- Direct the development of the watershed characterization for Liberty Reservoir
- Conduct stream corridor assessments within selected subwatersheds
- Develop action strategies within the selected subwatersheds based upon likely water quality concerns identified during the assessment that will identify causes of water quality degradation, prioritize types of impairment, and identify sources of funding and technical assistance.
- Identify opportunities to interact with landowners, citizen organizations, and other governmental agencies for the purposes of engaging cooperators and stakeholders as appropriate during the development and implementation of the WRAS.

DNR awarded Carroll County Government this grant in November 2001, but because of numerous delays, actual work did not begin until March 2002. Work related to the grant was completed in March 2003. WRPD was the primary responsible party; however, DNR's Watershed Restoration Division collected much of the water quality data used during the assessment phase of the process. To create the Liberty Reservoir WRAS, WRPD depended on cooperation from partner agencies. Assistance from many DNR agencies, the Carroll's Soil Conservation District, the Friends of Carroll County Streams, the City of Baltimore's Department of Public Works, the Reservoir Technical Group, and other county agencies all contributed to the success of this project, and it will be required for future implementation phases.

WRPD used the grant funding primarily to hire a WRAS coordinator. Given the time and staff constraints, the WRAS coordinator's role was crucial to the success of this project. The coordinator's major duties included updating and creating databases used to assess the condition

of the watershed, coordinating and managing three Stream Corridor Assessments (SCAs), and developing GIS data layers and maps.

There are eight sections of this report. After this brief introduction, Section Two reviews previous work related to watershed protection within the Liberty Reservoir Watershed. Section Three describes the watersheds used to develop the watershed assessment step in the process. Section Four describes the methods used to assess the watersheds selected. Section Five describes the data analysis procedure developed to determine the likely causes of stream impairments, and then it illustrates how the selected subwatersheds were prioritized. Section Six identifies educational opportunities already realized and in the future. Section Seven discusses the action strategies developed as solutions to the likely causes of stream impairments identified. Section Eight discusses next steps that the WRPD will take to begin implementing the Action Strategies developed.

II. On-going Efforts within the Liberty Reservoir Watershed

A. Reservoir Watershed Management Agreement

In 1984, the Reservoir Watershed Management Agreement was created to protect water quality of the three reservoirs (Loch Raven, Liberty, and Pretty Boy) owned and operated by the City of Baltimore. The agreement was signed by the City, surrounding counties (including Carroll), and regional and state agencies; it was recently reaffirmed in February 2003 with the endorsement of the current Board of Carroll County Commissioners. According to the 2000 Action Report for the Reservoir Watersheds (Baltimore Metropolitan Council, 2000), the agreement established “a voluntary, cooperative Reservoir Watershed Protection Program and an Action Strategy designed to improve water quality in the reservoirs and in its feeder streams. Focused on the twin goals for reducing phosphorus and sediment, the Action Strategy outlined specific action steps by each participating organization leading toward achievement of the Agreement’s goals.”

During the WRAS process, it was WRPD’s desire to complement this on-going regional effort of reservoir protection. The Action Reports contain recommendations for future work activities needed to enhance reservoir watershed protection efforts. By completing this WRAS, the following work activities have been partially addressed for the Liberty Reservoir Watershed:

- Improve tracking of best management practice (BMP) locations. WRPD has developed GIS data layers and maps showing specific locations of urban and agricultural BMPs.
- Reduce the dissolved phosphorus loads to the reservoir. Targeting stream buffer plantings in subwatersheds with elevated nutrient load estimates will in-part address this need.
- Target high priority areas for implementing agricultural BMPs through the subwatershed assessment and evaluation process.
- Evaluate increasing trends in nutrient and chloride levels within the reservoir. Implement the strategy to investigate sources of nutrient inputs to the reservoir will address this need.
- Improve public awareness. Conducting the Stream Corridor Assessments provided many opportunities for outreach and education. Developing an educational brochure will also improve public awareness of important watershed concepts.

B. SCA within the Cranberry Branch Watershed

DNR performed a SCA in 2000 (McCoy, 2000) in cooperation with the City of Westminster, MDE, and Carroll County to determine likely causes of taste and odor problems of the source water entering Westminster's drinking water treatment plant. The Cranberry Branch Watershed is located near the headwaters of the West Branch of the Patapsco River. Results from this assessment were used by MDE in part to fulfill U.S. Environmental Protection Agency requirements for a Source Water Assessment. The Cranberry Branch watershed is one of two watersheds that the City extracts surface water to supply the residents. The other watershed, the main stem of the West Branch of the Patapsco (also referred to as the Hull Branch) was not assessed at that time. The SCA performed during the WRAS process for the entire West Branch of the Patapsco River complements the existing information and will help to complete their Source Water Assessment.

III. Description of Watersheds Selected for Evaluation

WRPD selected two watersheds to initially develop the assessment and prioritization process: Middle Run (1056) and Snowdens Run (1046) (figure 2). WRPD selected Middle Run because of elevated pollutant loads derived from water sampling performed by the City of Baltimore. WRPD compared pollutant loads for each of Liberty's watersheds where data exist and when divided by watershed size, Middle and Bonds Run (two of the smallest) had the highest pollutant loads to the reservoir. WRPD also selected the Snowdens Run watershed for a more detailed watershed assessment. Historically, not much information has been collected about this suburban watershed located within the community of Eldersburg. In addition, Snowdens Run is located in close proximity to the water treatment plant intakes for the City and County. Table 1 compares the size of the major watersheds draining to the reservoir within Carroll County.

Table 1. Comparison of watersheds draining to Liberty Reservoir within Carroll County.

Watershed Name	Land Area (square miles)	Rank
Bonds Run	7.1	7
Beaver Run	14.3	3
Little Morgan Run	8.6	4
Morgan Run	28.9	2
Middle Run	8.4	5
Snowdens Run	8.0	6
North Branch of the Patapsco	41.6	1

Liberty Reservoir Watershed Restoration Action Strategy

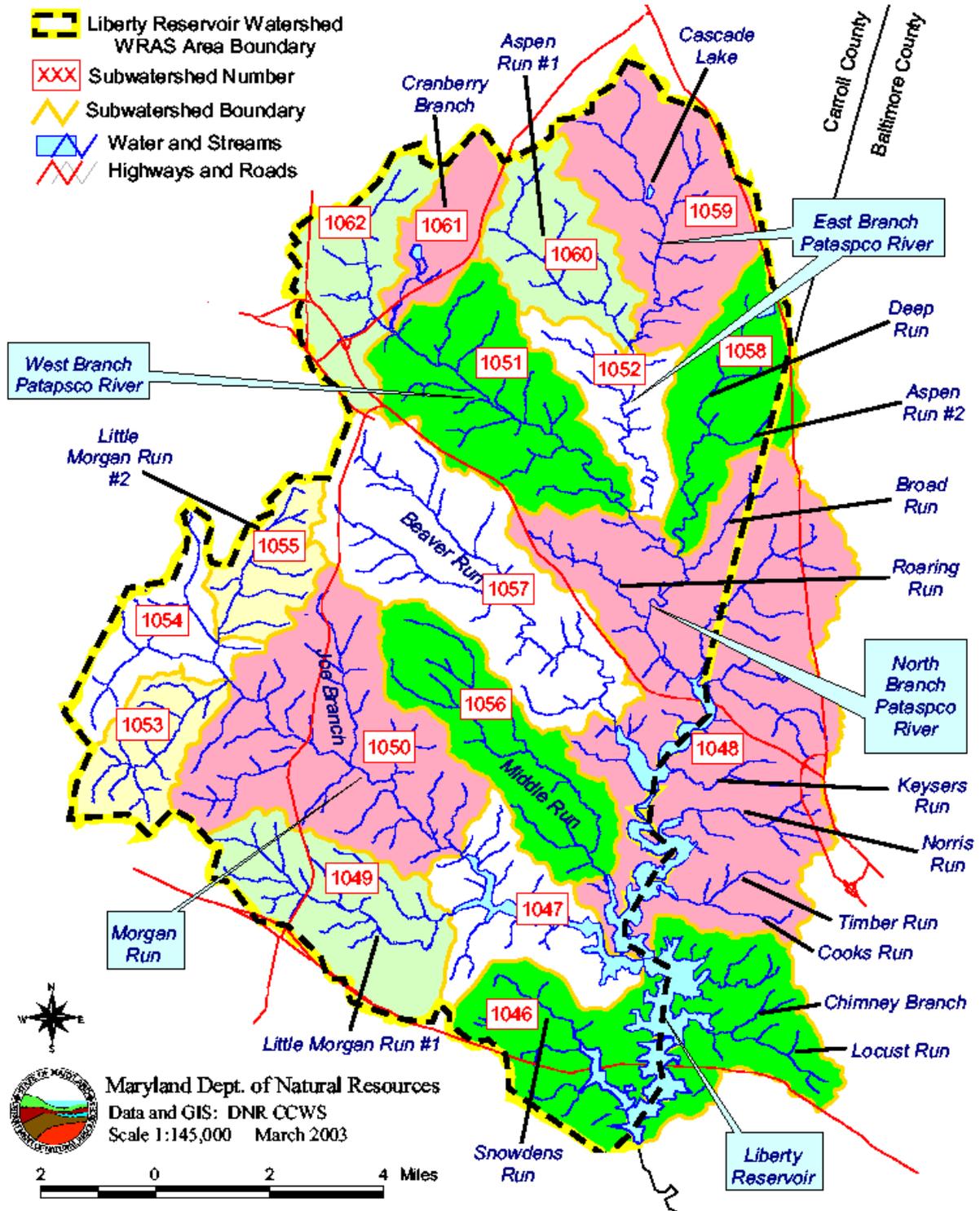


Figure 2: Subwatersheds Withinin The Liberty Reservoir Watershed

The Middle Run watershed is located in the south-central part of Carroll County. The boundary or drainage divide for this watershed is Route 32 to the south and Deer Park Road to the north. There are four roads that completely cross this watershed including (from north to south) Bird View Road, Niner Road, Gamber Road (Route 91) and Louisville Road. The size of this watershed is about 5,400 acres or 8.4 square miles. It comprises slightly more than 6% of the Liberty Reservoir watershed and less than 2% of the County’s land area (figure 3).

Agriculture is the dominant land use within this rural watershed (55%). Residential development is the next largest land use category (about 33%); it is mostly confined to the Route 32 and Deer Park Road corridors north of Route 91. Most of the residential land use is made up of single-family homes served exclusively by private well and septic systems. About 7% of Middle Run’s land area is publicly owned. The City of Baltimore owns almost all of the public land, and it is concentrated in the southern portion of the watershed near the reservoir. Carroll County owns a small park located at the top of the watershed called Deer Park; it is located near the intersections of Route 32 and Deer Park Roads. The road network comprises about 3% of this watershed. Forest covers approximately 21% of the land area largely concentrated near Liberty Reservoir on City of Baltimore property and along stream valleys in the central portions of the watershed. Almost 29 miles of streams receive runoff from this watershed.

Refer to Table 2 for a comparison of the major land uses for both of the study subwatersheds, Liberty Reservoir’s watershed and the county land area. Note that Middle Run’s land use distribution closely matches that of Liberty Reservoir.

Table 2. Major land use categories within Carroll County and selected watersheds

Land Use Category	Middle Run Watershed	Snowdens Run Watershed	Liberty Reservoir Watershed	Carroll County
Agriculture	55%	15%	53%	60%
Commercial/Industrial	<1%	5%	2%	1.5%
Residential	33%	32%	27%	20%
Publicly Owned	7%	36%	10%	5%
Other	4%	12%	8%	13.5%

The Snowdens Run watershed is located within Eldersburg in the southeast region of Carroll County and the southwest corner of the Liberty Reservoir watershed. The boundary for this watershed is Ridge Road to the south, Pine Knob Road to the north, and Route 32 to the west and the reservoir itself to the east. Route 26 (Liberty Road) divides the watershed almost in half (figure 4). Slightly smaller than Middle Run, the watershed area is about 5,100 acres or 8.0 square miles. It also comprises slightly more than 6% of the Liberty Reservoir watershed and less than 2% of the County's land area. The City of Baltimore reservoir property comprises about 36% of this watershed (a large part of the total is the reservoir itself). Similar to Middle Run, residential development comprises about 32% of this suburban watershed, and it is widely distributed throughout. Unlike residents within the Middle Run watersheds who are served by private wells, Carroll County provides public water from Liberty Reservoir and sewerage service to a large number of residents and businesses in Snowdens Run. Agriculture occupies only about 15% (compared with 55% for Middle Run). This watershed has a denser road network than Middle Run; it comprises about 6% of this watershed. Commercial land use comprises about 5% mostly concentrated along the Route 26 and 32 corridors. Almost 20 miles of streams receive runoff from this watershed. During the early 1990's, DNR Fisheries staff confirmed the presence of a native, brook trout population and proceeded to reclassify the stream system within this watershed to reflect this trout population. This discovery resulted in additional protective measures in the form of more stringent stream temperature requirements by the Maryland Department of the Environment during their review of development plans.

Liberty Reservoir Watershed Restoration Action Strategy

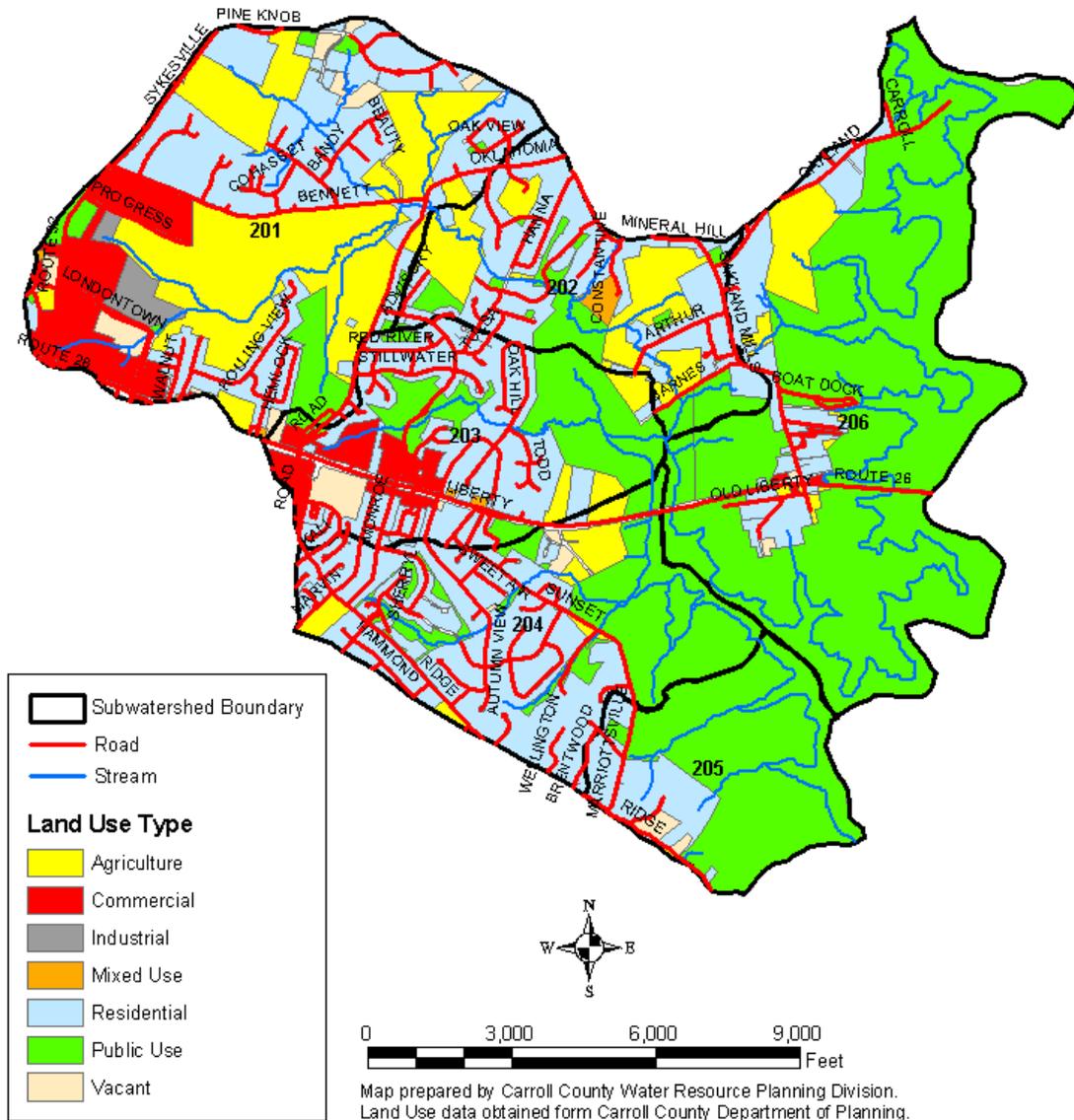


Figure 4. Snowdens Run Watershed

IV. Watershed Assessments

The watershed assessment step was the most time consuming step during the development of action strategies. It involved 1) gathering and updating watershed-related information from different locations into one location, 2) creating new data layers, 3) integrating data from many sources into one easy to use master database, and 4) working cooperatively with DNR staff to collect water quality information within the selected subwatersheds including visual assessments of stream corridors, nutrient levels, and biological information.

A. Gathering and updating existing information

Table 3 summarizes all of the data layers acquired and updated for this step in the process. Often, the information gathered was not updated nor in a format that could be readily incorporated into a GIS data layer; therefore, most of the information collected required manipulation to be useful. For instance, WRPD coordinated with County staff to verify the location of storm water management (SWM) facilities and correct missing or inaccurate coordinate information (figure 5).

Table 3. Data layers available to evaluate the condition of each watershed assessed.

Data Layer	Source
Agriculture Best Management Practices	County
Agriculture Easements and Districts	County
Agriculture Soil and Water Conservation Plans	County
Biological Monitoring Data	DNR, MBSS
Erodible and hydric soils along streams	County
Forest blocks	DNR Forest Service
Land Use	County
NPDES Industrial/Commercial Permitted dischargers	MDE
Parcel Lines	County
Pollutant load estimates	City of Baltimore
Recent, low-level, aerial photography	County
Roads	County
Storm drain outfalls	County
Storm water management facilities	County
Stream Corridor Assessment Data	County
Streams	County
Synoptic Nutrient Data	DNR/County
Water Resource Protection Easements	County
Watersheds (12 digit code watersheds)	DNR
Zoning	County

Liberty Reservoir Watershed Restoration Action Strategy

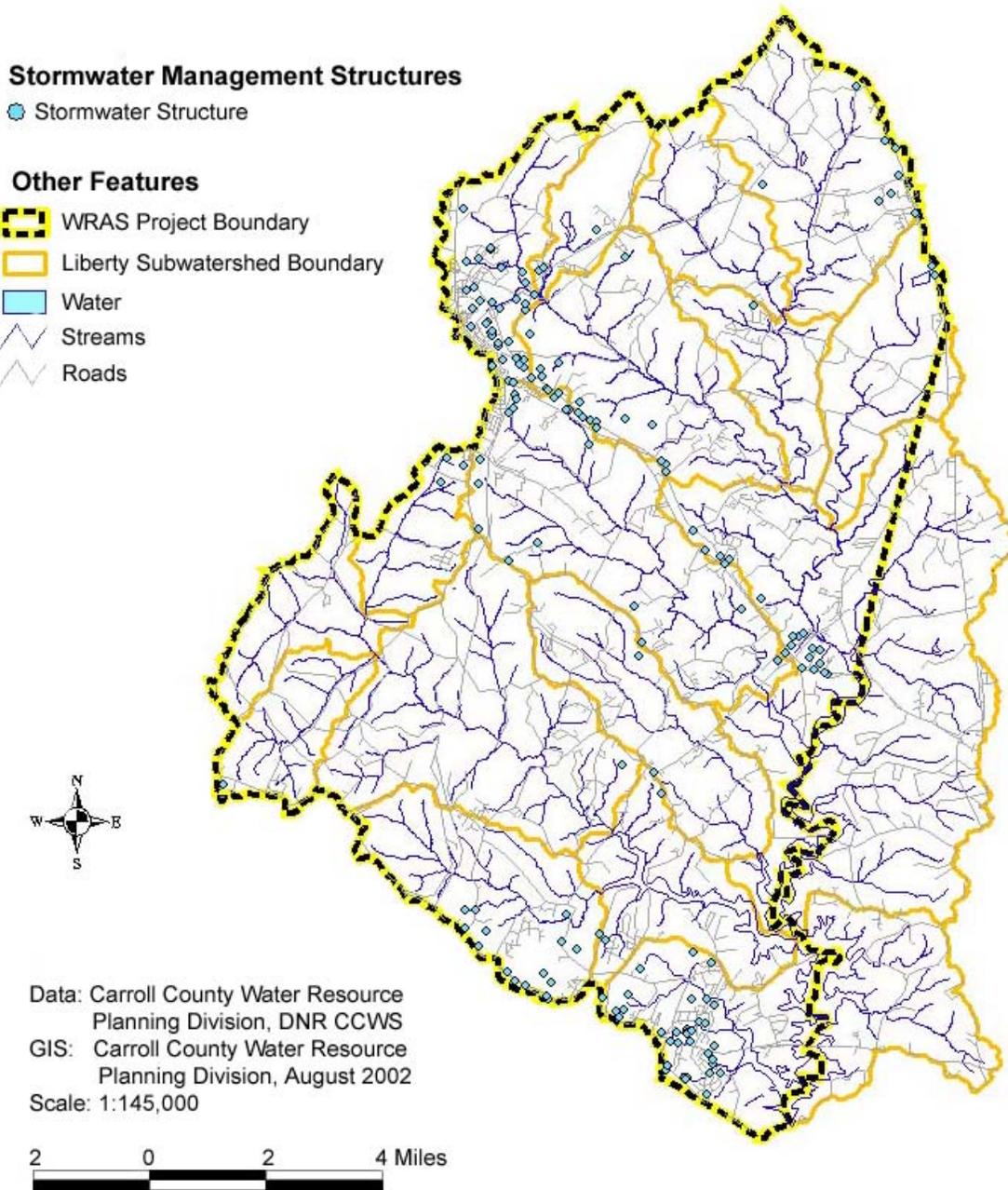


Figure 5: Stormwater Management Facility Locations

B. Creating new data layers

Where information needed for an assessment was not available, WRPD coordinated with WRAS partners and other agencies to obtain the information needed in a useful format. The WRAS coordinator, for example, visited the Carroll County Soil Conservation District (SCD) to obtain the location and type of *best management practices* (BMPs) within the Liberty Reservoir Watershed. ***Best management practices are measures designed to protect resources and are tailored to specific locations to reduce impacts to receiving streams.*** Examples of typical agricultural BMPs include fencing animals from streams to reduce eroded banks, planting vegetation next to streams, or establishing grassed waterways to promote filtration of runoff. Urban BMP examples include using erosion and sediment control measures during development and stormwater management after development.

As a result of this effort, it was determined that Carroll County's SCD has implemented 1,277 BMPs since 1980. The completion of this effort marks the first time that BMPs have been mapped in detail for subwatershed analysis in Carroll County. Figure 6 shows the distribution of these practices throughout the entire watershed as well as the distribution of agricultural preservation districts and easements. It also shows soil and water conservation plans written for farms within the three subwatersheds selected.

Creating a data layer of the locations of agricultural BMPs along with an updated SWM facility location database not only helped in the watershed evaluation step, but also fulfills a long-standing need for tracking BMP locations within the Liberty Reservoir Watershed. Knowing the location and type of BMPs will also improve the City of Baltimore's ability to assess the effects of BMPs on water quality.

Liberty Reservoir Watershed Restoration Action Strategy

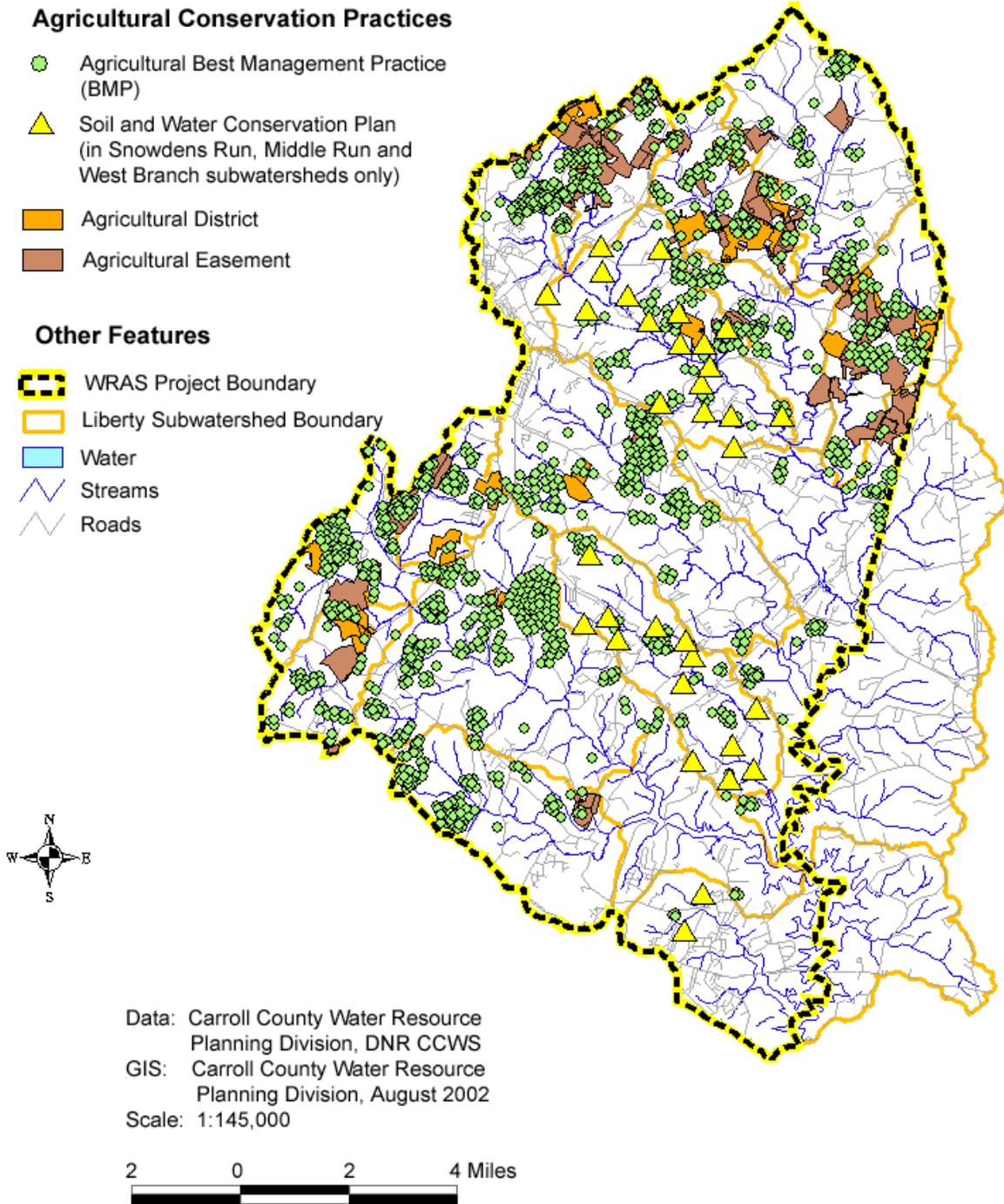


Figure 6: Agricultural Conservation Efforts

C. Water Resource Protection Easements

Since 1994, Carroll County Government has required a protective easement for streams and their buffers when land is subdivided. During the development review process, a Water Resource Protection Easement is platted and recorded over streams and all land within 100 feet of the stream channel. To date, 138 Water Resource Protection Easements have been recorded. Before the WRAS began, the ability to display the location of these easements on a map did not exist. Once completed, this information in map form will provide guidance as to which watersheds have some level of protection over the stream valleys. For example, new information can be gleaned quickly such as acreage totals or the total number of stream miles by watershed. This information can also be combined with the inadequate stream buffer information gathered from the SCA surveys to provide a basis for establishing stream corridor restoration goals.

D. Database Integration

A related goal accomplished during the study period made access to certain types of data much easier. WRPD has integrated and updated many databases into one relational database to facilitate easier and quicker access.

The county initially developed a water resource database as part of an effort to support decision-making for wellhead protection. This work was performed in the early 1990's using the dbase III software package. The information within the database was a compilation of numerous datasets from various agencies. Many of the datasets were created from paper files or other information and organized into a computer format for the first time. The database was always composed of individual datasets and thus was cumbersome to query. There have been numerous updates of this information within the datasets over the past decade with the last update occurring in 1998. In order to increase the efficiency of accessing the information, the conversion to Microsoft Access format and design of a truly relational database was proposed.

This entire process was undertaken to create an easier, more efficient, more effective method for querying data, enabling better mapping and analysis. By centralizing the information, the integrated water resource database also reduces the chance of wasting time and effort collecting and acquiring data that have already been obtained by another group or agency. A central database can also highlight gaps in datasets that may need to be filled.

Combining these databases proved to be a major undertaking. Records were kept of agency and personnel contacts as each dataset was acquired in the past. For certain databases, it was still only possible to obtain a paper copy. Electronic versions of these databases were created in Microsoft Excel. The next step was to modify each database to fit a universal format. Many different coordinate systems were used by the various agencies providing their datasets. To allow for easier mapping, all coordinates were converted to Maryland State Plane Coordinates NAD83 in feet. For any record lacking coordinates, they were collected using a combination of site visits and ArcView GIS. These individual databases were then added as tables within a master database designed in Microsoft Access. A unique tax account identification number was attached to each piece of property, so that a common field related records from different tables referring to the same piece of property.

Continually adding to and updating the information within the database is crucial to maintaining its value. A watershed cannot be accurately assessed without first gathering the most up-to-date information available, and that information cannot be properly used until it is

combined in an organized fashion. Pairing these efforts in the future will ensure the highest quality in data products and watershed plans. Table 4 below shows all of the data sources that were combined and related into one database.

Table 4. Data sources combined into one database.

Data	Source
Resource Conservation and Recovery Act (RCRA) Sites	United States Environmental Protection Agency (EPA)
RCRA Notifiers	EPA
Comprehensive Environmental Response Compensation and Liability Act (CERCLA Sites)	EPA
Sludge Storage Disposal Sites	Carroll County Health Department
Potential Contaminant Sources	Carroll County Water Resource Planning Division
Leaking Underground Storage Tank Locations	Maryland Department of the Environment (MDE), Oil Control Program
Spill Locations	MDE, Emergency Response Program
Carroll County “Right-to-Know” Locations	MDE, Toxic Registries Division
Hazardous Waste Generators	EPA
National Pollution Discharge Elimination System (NPDES) Sites (Industrial & Municipal)	MDE, Environmental Permits Service Center
Automotive Business Sites	Carroll County Water Resource Planning Division
Landfill Locations	Carroll County Water Resource Planning Division
Underground Storage Tank Locations	Carroll County Permits and Inspections Division
Junkyard Locations	Carroll County Water Resource Planning Division
Superfund Amendments and Reauthorization Act (SARA) Sites, Sections 311 & 312	MDE, Toxic Registries Division

E. Stream Corridor Assessments

Obtaining the current condition of the subwatersheds selected for evaluation is a critical component to the overall assessment of each watershed. WRPD needed a method that was relatively quick and inexpensive to implement, yet still provided an understanding of the watershed condition. Since the stream system receives runoff from the contributing watershed, streams can be thought of as the *barometers* of watershed condition. The Stream Corridor Assessment survey, developed by DNR’s Watershed Restoration Division, is one method to rapidly assess the physical condition of a stream system and identify the location of common impairments within a stream corridor (Yetman, 2001). The purpose of the SCA survey is to help resource managers identify the location of impairments to the stream and the opportunities for restoration and protection that may exist within a watershed (Yetman, 2001). There are four objectives to the SCA:

1. Generate a list of impairments within a stream system and along the stream corridor. The types of impairments identified during the SCA include:
 - Eroding stream banks
 - Inadequate stream buffers (defined as less than 50 feet of trees along the stream)
 - Fish migration blockages
 - Exposed or discharging pipes
 - Channelized stream sections
 - Trash dumping sites
 - In/near stream construction
 - Unusual conditions
2. Evaluate each impairment so that a preliminary determination of the severity, accessibility, and the ability to correct the impairment can be determined.
3. Generate information so that restoration efforts can be prioritized.
4. Provide a quick assessment of both in/near stream habitat conditions so that comparisons can be made among different stream segments.

Field crews of three or four individuals walk the stream corridors and collect descriptive information about impairments observed. When an impairment is observed, field crews assign a unique number, take photographs, record map coordinates, and locate the impairment on a map. Together, field crew members also evaluate and determine the severity, the accessibility, and the ability to correct each impairment encountered.

As part of the DNR contribution to the development of the WRAS, the Maryland Conservation Corps (MCC), under the direction of DNR, performed Stream Corridor Assessments (SCAs) for the Middle Run and Snowdens Run watersheds in the spring and summer of 2002. Carroll County’s Water Resource Planning staff, with assistance from other county employees, conducted a SCA for the West Branch of the Patapsco River watershed in the fall of 2002. All crews received training from DNR in the protocols developed and established by the Watershed Restoration Division (Yetman, 2001). This helped to ensure that survey results would be consistent and comparable. During the first few days of the SCA, DNR staff also accompanied field crews to further assure consistency in the data collection methods.

As a result of the permission process developed, SCA crews visually assessed 68% and 89% of the stream miles within the Middle Run and Snowdens Run watersheds respectively. In addition, SCA crews walked 77% of the total stream miles within the West Branch of the Patapsco watershed. Refer to table 5 for specific information.

Table 5. Watershed Coverage by Stream Corridor Assessments

Watershed	Percent of Landowners who Granted Permission	Stream Miles within Watershed	Percent of Stream miles Assessed via SCA field crews
Middle Run	77%	28.8	68%
Snowdens Run	83%	20	89%
West Branch	70%	75	77%
Totals	74%	123.8	77%

WRPD decided to conduct the stream survey for the West Branch using its own personnel in order to become familiar with, and proficient in, the assessment techniques being used. There were two advantages to conducting the SCA with County staff. First, being involved directly in the data collection would make staff better able to carry out analysis of the results. Their knowledge of the strengths and limitations of the information would allow them to maximize the applications of the data. Second, it gives the county the option of performing future SCAs to monitor the success of restoration efforts. The Cranberry Branch portion of the West Branch watershed was excluded from the SCA performed in 2002 because DNR's Chesapeake and Coastal Watershed Service performed a SCA there in April of 2000 (McCoy, 2000).

In addition to the standard data collected in the course of the SCA, Carroll County added map coordinates to integrate the data into the Geographic Information System (GIS) program used by the County (ArcView 8.1). Through this grant, the County purchased handheld GPS units, which were given to MCC crews and County staff for use during the stream walks. The Magellan Meridian Platinum units used the Wide Area Augmentation System (WAAS) to achieve accuracy to three meters. Coordinates collected were Universal Transverse Mercator (UTM) North American Datum of 1983 (NAD83) in meters and then converted to Maryland State Plane NAD83 in feet.

WRPD modified the SCA method to improve the accuracy of locating and revisiting stream impairment sites and to quantitatively measure linear impairments found (e.g., altered stream channels, eroding stream banks, inadequate stream buffers). Field crews collected a single coordinate for impairments at specific locations (e.g., pipe outfalls, fish barriers), but when the impairment was dispersed over a length of the stream coordinates were recorded at both ends of the impaired stream segment. Using the sets of coordinate pairs, the County was able to create a map layer of lines representing the extent of impairments. This enabled County staff to more accurately measure the actual length of stream impairment compared with estimates made by field crews. When displayed as a data layer, this improvement provided a much better indication of the number and distribution of the all of the stream impairments. Refer to figures 12 and 13 for examples showing the extent of eroding stream banks within the Middle and Snowdens Run watersheds.

1. Landowner Permission Process

Carroll County employed a highly successful process for obtaining landowner permissions that may serve as a model for other counties wishing to perform SCAs. Initially, letters were sent out to all landowners in the watershed who had properties containing streams, explaining the purpose of the assessment and what would be done while the assessment crew was on their property. A contact number was included in case they had further questions regarding the survey. Enclosed was a postage paid reply card where the owner could check a box granting or denying permission and a space for a signature (figure 7). After 2-3 weeks, landowners who had not responded were contacted by phone and permission was obtained verbally. If a landowner could not be reached by phone, due to a changed number or the inability to find a number, a second letter and reply card were sent. Landowners who did not respond to either phone calls or the letters were assumed to deny permission. A Microsoft Access database was kept of landowners who returned cards and whether or not permission was granted. After the stream walks were completed, a thank you card was sent to landowners who had granted access to their property (figure 8). In addition to showing appreciation for their

cooperation, the cards also included information about the percentage of landowners involved in the SCA. Landowners could see how successful the effort had been, and that they were not alone in their decision to participate.

Please indicate your choice:

I grant permission for a stream corridor assessment to be conducted on my property.

I do not grant permission for a stream corridor assessment to be conducted on my property.

Name (please print) _____

Signature Date

Figure 7. Landowner Permission postcard



Thank you for your cooperation in this important step to assess the water quality of streams draining to Liberty Reservoir. By assisting us in this effort, you were among the ??% of the landowners in the XX watershed who granted us permission. Please contact Carroll County Water Resources staff at 410.386.2145 if you have any water resources related questions or concerns.

*Carroll County Bureau of
Water Management*

Presorted
First-Class Mail
U.S. Postage Paid
Westminster, MD
Permit No. 347

Figure 8. Reply card to cooperating landowners

This process had many advantages, though it proved to be time-consuming. Within each watershed, a high percentage of landowners granted permission; Snowden's Run (83%), Middle Run (77%), West Branch (70%). By not assuming permission was granted if there was a lack of response, conflicts with landowners were avoided. Also, some landowners wished to be present when the crew was on their property or know in advance the exact time of the survey visit. Others wished to see the results of the survey. The reply cards and contact numbers gave those landowners the opportunity to make special requests. The permissions database included fields for pre-visit phone calls and report requests.

One of the most important steps in this process proved to be the phone calls made to landowners who had not responded to our letters. Many had tossed the letters aside assuming

they were junk mail, or letters or reply cards were lost and they were unsure who to contact in order to grant permission. Landowners who were under the impression that they were being singled out had the survey explained in greater detail. Those who were worried about being held responsible for fixing the impairments found by the crew were reassured that this assessment was being undertaken as a planning tool, and not as a method for assigning blame or billing landowners for impairments that are usually beyond the control of any one person. By addressing these concerns and opening the lines of communication with property holders, the County had access to many more stream miles than would otherwise have been the case. Once the concerns of landowners had been addressed, some offered to explain the process to neighbors who had had similar misconceptions about the survey. Word of mouth was an important factor in gaining access to properties where owners were unsure of the County's intentions. The County could have asked for no better spokesperson than a trusted neighbor or friend.

Landowners also provided the County with valuable information that promoted the safety of the survey crews. Some had dogs that needed to be secured before the crew entered the property, others knew of large deposits of broken glass, or areas where there was hunting or target practice. They also suggested practical advice regarding the best route to take when hiking in to the stream or which side of the stream had fewer briars. Several times the use of private driveways was offered on roads where parking would have been difficult otherwise.

While property owners could not offer scientific data on the stream, many took the time to offer narrative accounts of stream condition. Some have lived on the same piece of land for as many as 50 years. The SCAs were performed during a severe drought and landowners offered comparisons among stream flows during normal years and droughts in the past. Others recounted changes they had seen in the stream as the surrounding landscape was altered, such as erosion and sedimentation they noticed when development occurred upstream or how springs had dried up for the first time in 30 years.

All of this information was useful for several reasons. While these observations are not scientific in nature, they are coming from sources that are intimately acquainted with the properties and the streams running through them. It is not possible to go back and develop baseline data, but these narrative accounts offer an alternative starting point for developing knowledge of the stream system. Another benefit is involving the public in the assessment process. Dialogue that occurs while the survey is being conducted helps to enhance the owner's understanding of the motivation behind conducting such a survey. It also helps to build the relationship between the County government and citizens. People want to know that steps are being taken to protect what matters to them, and by addressing issues that directly concern their property they see firsthand that the County is actively working to improve conditions within the watershed.

This contact also builds the foundation for future restoration efforts. Few, if any projects can be completed when a landowner has denied access to a property. By having been involved in the assessment phase, future projects are put in context for the landowners. They see that there is a complete process to addressing watershed health. It is also hoped that a previous, positive experience with the County will encourage owners to allow further access to their land, and show that their prior cooperation was to their benefit, in the form of County help in improving the watershed condition and in turn their water supply.

Carroll County highly recommends this process of obtaining landowner permissions as more than a simple means of obtaining permission to complete the survey, but as a means of building and strengthening relationships between the County and its citizens. It was not

undertaken with the intent of developing a dialogue with the citizens, but the partnership that developed was an invaluable benefit and well worth the extra time that was involved with contacting property owners on an individual basis. Time spent during this early phase of the project should be considered an investment in the long-term goals of the WRAS.

2. Refinements to SCA Data Collection Methods

WRPD tailored the method of collecting data during the SCA to local needs. Before the stream walks began, WRPD staff discussed the likelihood of inaccurately recording stream impairments on aerial maps, especially in heavily wooded areas with no recognizable landmarks nearby. To improve accuracy, WRPD purchased hand-held Magellan Platinum global positioning system (GPS) units to record coordinates for each impairment observed. The GPS units are equipped with the WAAS option that provides greater accuracy (accurate to within 10 feet). The GPS units proved easy to use, although a quick conversion is required from the UTM projection to MD State Plane coordinates. Coordinates were not stored directly into the GPS unit, but were recorded directly onto a data sheet. WRPD will continue to use the GPS units for subsequent SCAs. This technology greatly improved the accuracy of the results without adding much additional office work or additional burden for the field crews.

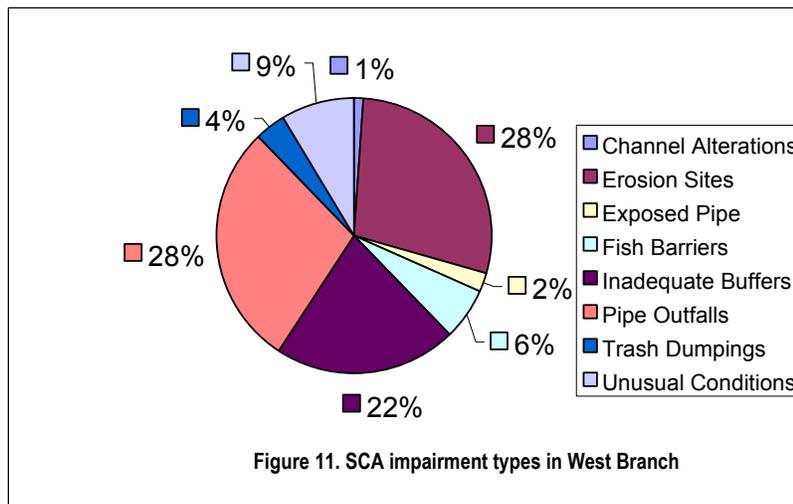
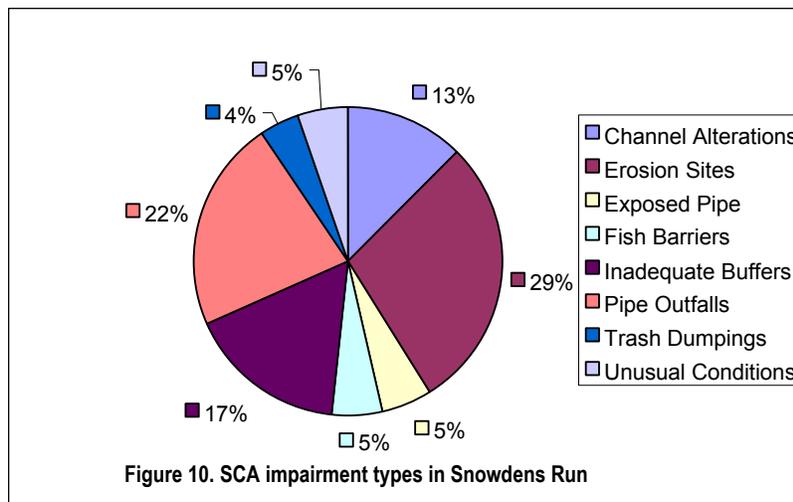
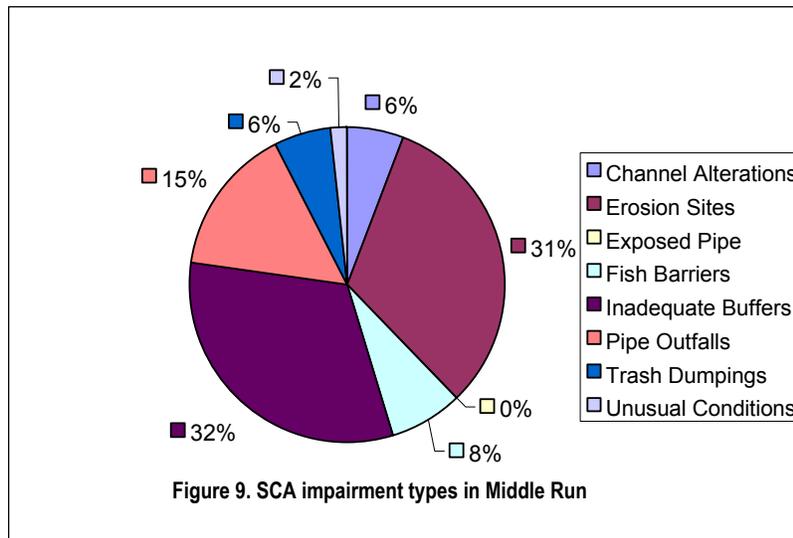
During the next SCA, scheduled for completion in spring of 2003, WRPD is field-testing the possibility of linking the ArcPad software loaded onto a hand-held computer to the Magellan GPS units. Linking the two units will automate the download of coordinates directly into a data entry form, will save time, and will reduce data entry errors.

Another modification to the SCA method WRPD adopted also relates to the use of the GPS units. Two stream impairments types (erosion sites and inadequate buffers) are linear in nature; they are not simply point layers like a pipe outfall or a trash dump. WRPD anticipated this difference by recording the coordinates at the beginning and the end of these impairments. This simple idea greatly improved the usefulness of this information. Displaying the results spatially allowed a much better idea of the extent of these linear stream impairments. When combined with color-coded severity rankings, WRPD was able to quickly determine problem areas and compare the linear extent of those impairments.

3. Summary of Results

The DNR compiled all of the data and summarized findings into a report titled Liberty Reservoir, A Stream Corridor Assessment of Selected Subwatersheds. This report can be accessed on-line at http://dnrweb.dnr.state.md.us/download/bays/libres_sca.pdf. Refer to figures 9 through 11 for a summary of impairments discovered from each watershed surveyed. Within Middle Run, eroding stream banks (31%) and inadequate stream buffers (32%) were most often encountered. Field crews observed eroding stream bank (29%) and pipe outfall (22%) impairments most often within Snowdens Run. For the much larger West Branch watershed, eroding stream banks and pipe outfalls each represent 28% of the total number of impairments recorded.

LIBERTY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY



F. Water Quality Data Collected by DNR Staff

DNR also provided assistance during this step of the WRAS development by collecting synoptic, biological and nutrient (nitrate-nitrogen, ortho-phosphate phosphorus) water quality data for the three watersheds selected. WRPD and DNR staff selected stations to complement the limited monitoring data that exists in these watersheds. DNR staff collected nutrient data from all three selected subwatersheds, but collected only biological monitoring data (aquatic insects, fish, and physical stream habitat data) from Middle and Snowdens Run subwatersheds. Nutrient water quality results from this effort suggest that Middle Run watershed contributes a greater loading of nutrients to the reservoir than Snowdens Run. Results from most sites suggest the aquatic insect community is in fair to good condition. Methods used here are consistent with methods used by the DNR's Maryland Biological Stream Survey (MBSS). MBSS is a state-wide effort to assess the biological condition of streams throughout Maryland; therefore, comparisons can be made between those efforts. With few exceptions, MBSS data suggest similar biological condition for the aquatic insect community in Middle Run. For the Snowdens Run subwatershed, there are only eight sampling stations between both efforts, so no comparisons are offered here. Results from the physical habitat assessments are consistent with the large number of eroding stream banks noted during the SCA. Sediment eroding from stream banks is deposited in the pools and riffles of the stream system reducing the quality and quantity of available habitat for the fish and insect communities (DNR CCWS, September, 2002). Please visit DNR's web site to read or download this report at http://dnrweb.dnr.state.md.us/download/bays/libres_synoptic.pdf

WRPD was unable to place the dry weather pollutant loading results in context because of the absence of a state nutrient standard. After the information was manipulated to calculate pollutant loads by subwatershed, WRPD was able to rank nutrient loads relative to all other subwatershed within Middle and Snowdens. Results from Middle Run were greater than loadings from Snowdens Run. From this limited application, WRPD may focus on Middle Run if levels reported are truly elevated compared with future, state standards. The nutrient information, however, is a useful starting point for more detailed investigations to track the potential sources of elevated loadings. WRPD is planning to meet with the City of Baltimore and Baltimore County to develop a cooperative plan to determine the possible sources of elevated nutrient loadings (see the Nutrient Source Tracking Strategy on page 38).

V. Watershed Evaluation and Prioritization

The next step, and perhaps the most challenging one, was to determine how to combine and evaluate all of the information in a way that enables the County to begin to associate those impairments or symptoms observed in the stream systems via the SCA with the likely causes of impairment. This method of analysis had to be flexible enough to be used in different watersheds. For instance, the two watersheds WRPD initially evaluated have different land uses, development pressures, and drainage patterns. The next watershed likely evaluated, the West Branch of the Patapsco River, has a much larger drainage area with unique, local water supply issues related to the City of Westminster that are different from the other two watersheds evaluated.

Each data layer was plotted separately on a transparency to facilitate easy and quick combinations of data layers. WRPD further divided both Middle and Snowdens Run watersheds into smaller subwatersheds. It was then possible to target subwatersheds that consistently

showed impairments and likely causes of those impairments. Using the subwatershed as a base map provided comparisons among different regions within the larger watersheds and allowed WRPD to target areas for restoration. This low-cost, yet effective method proved useful to decide if an apparent cause and effect relationship existed.

A. Watershed Protection and Restoration Opportunities

The process of identifying watershed protection and restoration opportunities and assigning each watershed an action category was taken in part from the State of Oregon Watershed Assessment Manual (Watershed Professional Network, 1999). According to the Oregon Watershed Assessment Manual, “*Protecting aquatic and stream corridor habitat that currently supports good stream habitat, healthy fish populations, and good water quality is an excellent strategy. It is usually much more efficient and less costly to protect an area that is functioning in a healthy way than it is to restore conditions once they have been degraded.*” Other counties in Maryland (e.g., Baltimore, Montgomery) use a similar process to assign categories to watersheds based upon the results of watershed assessments.

The three categories chosen for this effort are restoration, protection, and further study. WRPD assigned watersheds to the *restoration category* if a likely connection between an impairment observed in the stream system and a cause of the impairment could be made during the evaluation process, and a solution (action strategy) could be proposed that would address the cause(s) of the impairment. If it was evident to WRPD that little or no impairments were found as a result of the SCA and existing water quality monitoring data showed good conditions, then that watershed was assigned the *protection category*. For the third prioritization category, *further study*, WRPD assigned watersheds this category where likely cause and effect relationships could not be determined or where sufficient water quality monitoring data did not exist. It would not be prudent to use limited funding in these subwatersheds because not enough information has been gathered to clearly decide what actions need to be taken.

1. Middle Run Watershed

Using this watershed evaluation process for the Middle Run watershed, WRPD discovered that there are only two stormwater management (SWM) ponds in the *entire* watershed; however, many more storm drain outfalls are present conveying untreated storm water directly to the receiving stream system (figure 12). This implies that almost all of the residential subdivisions within this watershed were constructed before Maryland’s stormwater law was enacted and implemented in Carroll County. Unmanaged storm flows entering stream channels cause a series of harmful effects to the physical aspects of streams; the recognition of the effect of stormwater on receiving streams was one of the primary reasons for creating this law (Martin Covington, personal communication). For instance, eroded stream banks are one of the most serious consequences of not managing storm water runoff. Before development occurs, runoff enters the stream system slowly either through infiltration of stormwater into the groundwater recharging the streams as baseflow or running off the land through vegetation entering the system at many, sometimes diffuse points. In contrast, once development occurs, storm flows are quickly collected and concentrated via curbed streets and storm drains directly into the system at only a few points. The natural size of the receiving stream channels is not large enough to accommodate the larger volumes of runoff (accompanied by a host of potential pollutants) and this causes stream banks to erode and widen in an “attempt” to convey the flow

downstream. Through this analysis, a probable cause and effect relationship exists for portions of the Middle Run watershed. By overlaying the stormwater infrastructure with observed, stream channel impairments, this link has been made in the upper portion of subwatersheds #102 through 104 where several, older, residential subdivisions exist without the benefit of SWM. Opportunities may exist to add SWM facilities to residential areas identified with the most severe eroding stream banks downstream from a development. Proposed solutions to address the likely cause of the eroding stream banks near residential subdivisions will be discussed in action strategy #2.

WRPD used a similar process to evaluate each of the subwatersheds within Middle Run and then assign an appropriate action category. What follows is a brief description of the specific issues that should be priorities for action for each of the Middle Run subwatershed.

Subwatershed 101 requires further study before a more definitive category can be assigned. Specifically, more nutrient data should be collected before restoration or protection opportunities are identified; however, restoration opportunities may exist to remove two trash dumps identified within this subwatershed.

For subwatershed 102, almost ½ mile of eroding stream banks occur downstream of three storm drain pipe outlets that convey unmanaged stormwater. Biological monitoring results in the good to fair range for three locations within 102 suggest that water quality appears to be adequate. No other significant restoration needs were identified; however, two important protective measures should be considered. First, a large majority of streams were well buffered with forest, and protection efforts should be made to maintain this vegetation. Second, there appears to be little or no participation in local programs offered by the Carroll Soil Conservation District (SCD). The SCD could target this watershed to protect existing stream buffers.

Subwatershed 103 is one of the smallest subwatersheds, yet proved to be the top priority for restoration within Middle Run. Almost all of the streams within 103 have eroding stream banks; furthermore, field crews rated these stream banks as the most severe in the entire Middle Run watershed. Similarly, almost all of the stream miles lacked an adequate, forested stream buffer, which were also rated as most severe. Nutrient loading data provided additional assurance that 103 should be assigned the restoration category. Nutrient loadings from the central portion of 103 were by far the highest of any subwatershed within Middle and Snowdens Run during drought conditions of the spring of 2002. Further study of nutrient loading data is needed to determine possible sources.

Subwatershed 104 provides equal opportunities for restoration and resource protection. For the upper portion of 104 (northwest of Birdview Road) the link is evident between the long lengths of eroding stream banks (1-2 miles) and the unmanaged stormwater conveyed to the stream system via 12 storm drain pipe outlets. In addition, three opportunities exist to clean up trash at three dumps identified during the SCA. In contrast to 103, inadequate stream buffers are not as serious an issue in 104. Many opportunities exist for the SCD to concentrate in lower half of this subwatershed. Possibilities for protection and restoration include filling in gaps in the streamside forest buffer and contacting landowners to develop and implement soil and water conservation practices.

Liberty Reservoir Watershed Restoration Action Strategy

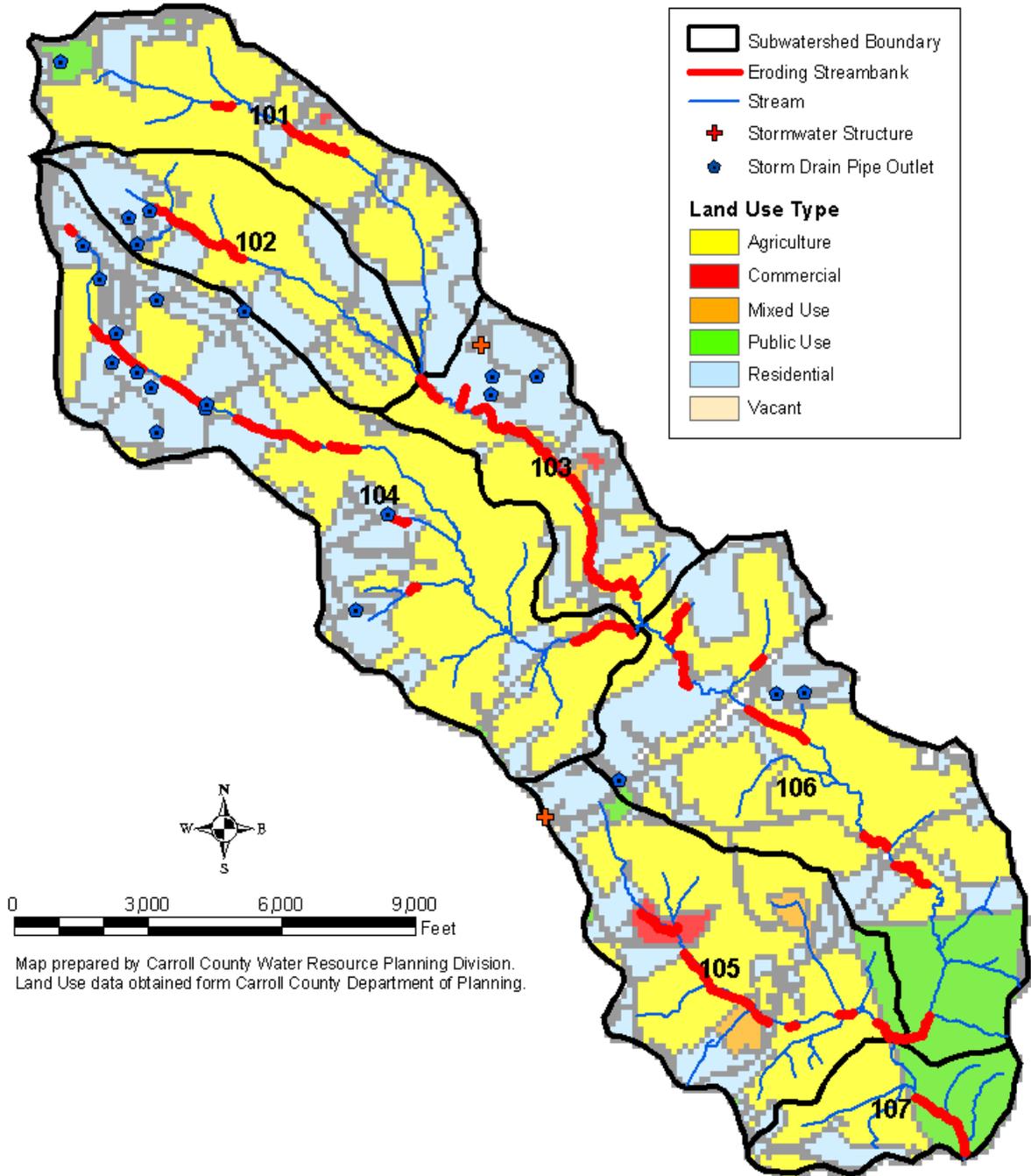


Figure 12. Eroding stream banks down stream of storm drain pipe outlets within the Middle Run Watershed.

Resource protection should be the focus within subwatershed 105 because of the relatively minor impacts observed. Nutrient loads were among the lowest per acre in Middle Run, and most of the streams were adequately buffered; however, there may be opportunities available. The SCD could target this area to 1) cooperate with landowners to plant trees along streams that lack adequate buffers, 2) implement BMPs on agriculture land with previously written soil and water conservation plans, and 3) target land with eroding stream banks observed within this watershed for restoration. Further study is needed due to the lack of existing water quality data.

Subwatershed 106 is the third priority for restoration after 103 and 104. Nutrient yields were relatively high in the middle third of 106 compared with the other subwatersheds in Middle Run; furthermore, field crews observed significant lengths of both eroding stream banks and inadequate buffers throughout 106. For resource protection, a majority of the land within 106 remains in agricultural use and ample opportunities on agricultural land may exist. Similar to 105, SCD could target areas to implement BMPs on agriculture land with previously written soil and water conservation plans. The City of Baltimore property provides protection for most of the lower portions of 106. Further study is needed to determine if the relatively high nutrient values extend to other areas within this subwatershed.

Subwatershed 107 has the smallest area and is adjacent to City owned property. Because of the low nutrient yields observed and the adequate stream buffers the primary focus should be resource protection. Further study is needed to determine existing water quality conditions. Table 6 summarizes the category selection and rank for each subwatershed within Middle Run.

Table 6. Action Category Assignments for subwatersheds within Middle Run.

Watershed Number	Rank within Primary Category	Primary Categorization	Secondary Categorization	Tertiary Categorization
101	1	Further study	Restoration	Protection
102	4	Restoration	Protection	Further study
103	1	Restoration	Further study	Protection
104	2	Restoration	Protection	Further study
105	1	Protection	Further study	Restoration
106	3	Restoration	Protection	Further study
107	2	Protection	Further study	Restoration

2. Snowdens Run Watershed

When compared with results from Middle Run, it is evident that opportunities to improve watershed conditions should be investigated within Middle Run *before* Snowdens Run. This may seem strange considering the suburban land uses present accompanied by a higher percentage of *impervious cover* within Snowdens. ***Impervious cover is a consequence of development preventing storm water from soaking into the ground. Instead, stormwater runs off roads, parking lots, roofs, etc. directly into a nearby stream effectively skipping an important step in the water cycle.*** The generalization that streams within urban watersheds are

more degraded than watersheds with lower percentages of impervious cover may not apply when comparing Snowdens and Middle Run.

Many more SWM facilities exist within Snowdens (33) compared with Middle Run (2) indicating more recent development. Similarly, many more storm drain pipe outlets conveying untreated stormwater runoff exist within Snowdens than Middle Run (figure 13). However, even with the greater concentration of stormwater infrastructure, field crews documented much *less* stream bank erosion within Snowdens (1.9 miles or 11% of stream miles surveyed) compared to Middle Run (6.7 miles or 34% of the stream miles surveyed). Furthermore, the severity of eroding stream banks was much less in Snowdens Run. Refer to the figure 14 below for the distribution of severity ratings. Figure 14 shows that 40% of the eroding stream banks within Middle Run were rated as either very severe or severe compared with only 11% in Snowdens.

Liberty Reservoir Watershed Restoration Action Strategy

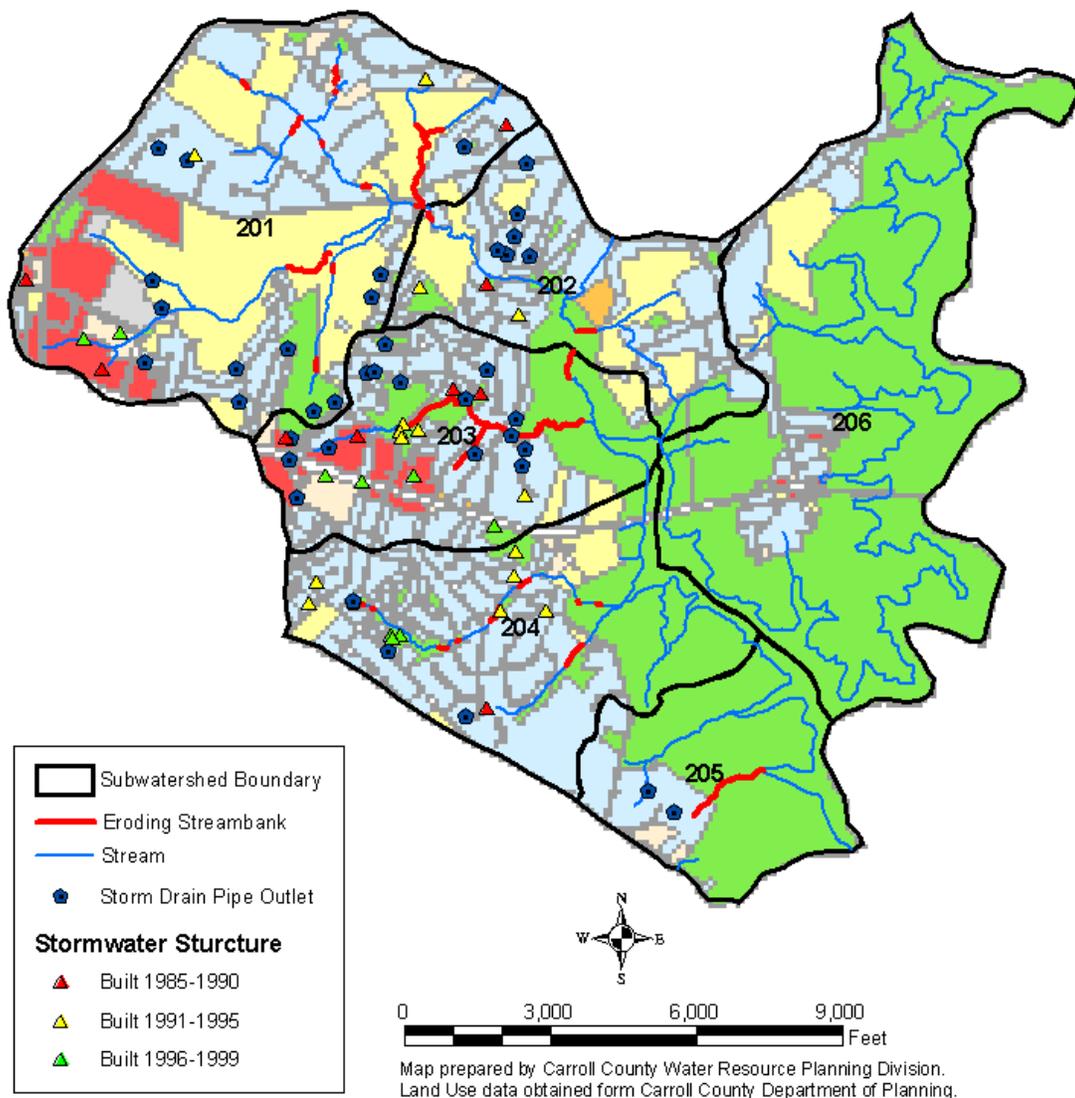


Figure 13. Eroding banks down stream of stormwater infrastructure within the Snowdens Run Watershed

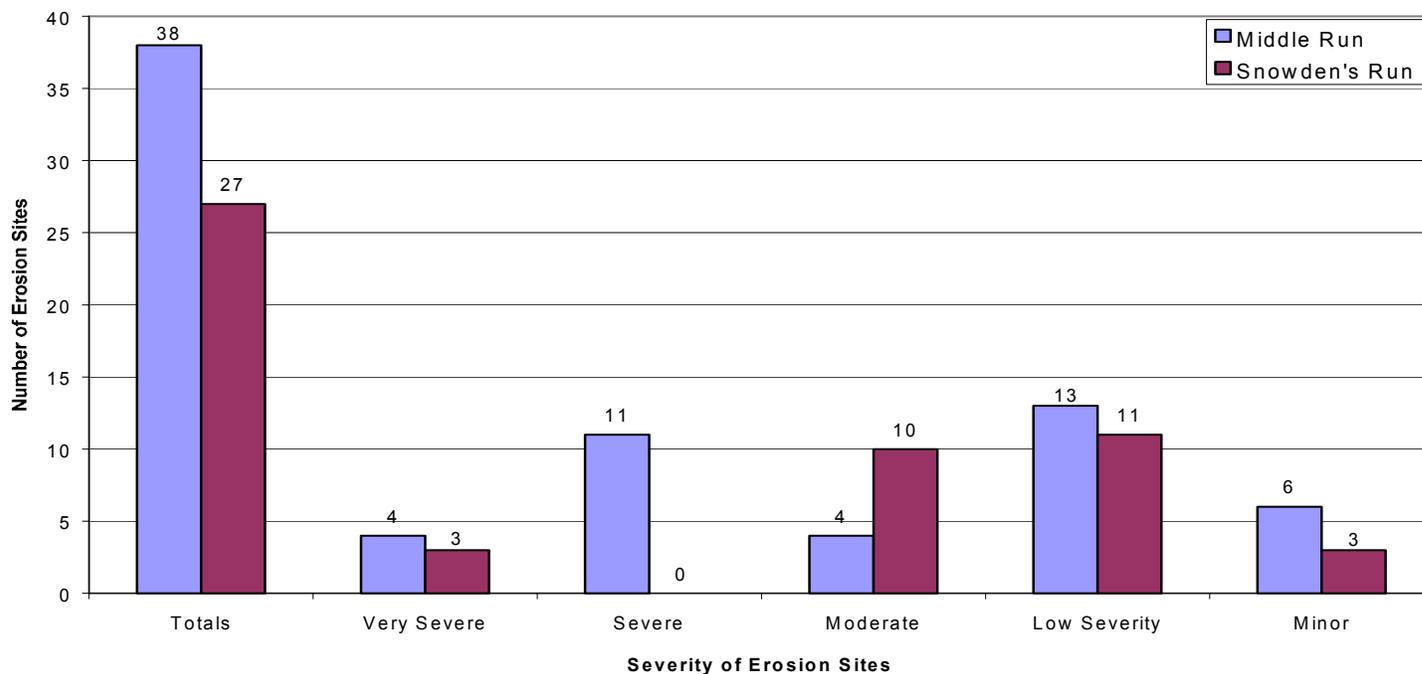


Figure 14. Severity ratings of erosion sites within Middle Run and Snowdens Run Watersheds.

The aging SWM facilities within this subwatershed may provide excellent opportunities in the future for updating to current state standards. Twenty-four SWM facilities (73%) were constructed before 1995; nine facilities (27%) were constructed before 1990. Many of the older SWM facilities within the county, especially those constructed before 1990, lack a sufficient number of storm drain inlets to allow runoff to reach the facilities (Martin Covington, personal communication). In most cases, a relatively inexpensive solution would be to construct additional storm drain inlets allowing a much larger volume of runoff to reach the SWM facility.

Sufficient water quality information has not been collected for streams throughout this watershed; consequently, further study is the first action recommended for two of the six subwatersheds evaluated. Further study within Snowdens should also include targeted monitoring at potential contaminant sources largely concentrated within subwatersheds 201 and 203. This investigation could be accomplished with the implementation of a cooperative effort with the City of Baltimore to track sources of nutrients. The City of Baltimore's Environmental Services Division also collects water quality data for streams within City property. Their data should be a valuable source of information because of the close proximity of Snowdens Run to City property.

While the City of Baltimore owns the majority of the forested land within Snowdens, protective measures should include preserving the remaining forested land where possible outside of the City's reservoir property.

Within subwatershed 201, there are many opportunities for restoration similar to 203. For example, several residential areas lack an adequate stream buffer, and seven SWM facilities are within this subwatershed as are many storm drain pipe outlets conveying untreated stormwater runoff.

Both subwatersheds 202 and 204 were assigned the further study category due to relatively minor impairments noted during the SCA and the lack of water quality data.

Opportunities for watershed restoration also exist in both subwatersheds. Field crews identified three trash dumps throughout Snowdens, and all were within subwatershed 202. Within 204, there is a relatively long section of stream lacking an adequate stream buffer (moderate severity).

For subwatershed 203, large number of SWM facilities (about 40% of the total) within this watershed combined with an even larger number of storm drain outlets conveying unmanaged runoff are likely causes for the eroding stream banks downstream. Field crews observed the majority of eroding stream banks within 203 (see figure 13). It is interesting to note that virtually all of the streams in 203 were adequately buffered with trees, yet in this case it appears that stormwater runoff has caused significant stream bank erosion even though the stream valley is buffered with trees. Replanting stream buffers, while a valuable BMP cannot be the only tool in a resource manager’s toolbox for effective watershed management. Even with all of the historical development that has occurred throughout this subwatershed, biological monitoring results from the only monitoring site in 203 indicate good conditions for the aquatic insect community (Stranko et al, 2001). Field crews identified the most significant barrier to fish migration within 203. It partially prevents fish from accessing about a one mile stretch upstream of this barrier. For all of these reasons, restoration activities should be targeted initially within subwatershed 203.

There is a long, severe section of eroding stream banks downstream from two storm drains conveying unmanaged runoff within 205. Attention should then be directed toward protection of existing adequate stream buffers outside of City property.

For subwatershed 206, field crews observed just a few, minor impairments within this watershed mostly owned by the City of Baltimore; consequently it was assigned to the protection category. There are a few areas within 206 that are currently in agriculture use and adjacent to City property that may provide opportunities to establish protective easements in the future. Refer to table 7 below, which summarizes ranking and category assignments for each subwatershed within Snowdens Run.

Table 7. Action Category Assignments for subwatersheds within Snowdens Run

Watershed Number	Rank within Primary Category	Primary Categorization	Secondary Categorization	Tertiary Categorization
201	2	Restoration	Further study	Protection
202	1	Further study	Protection	Restoration
203	1	Restoration	Further study	Protection
204	2	Further study	Restoration	Protection
205	3	Restoration	Protection	Further study
206	1	Protection	Further study	Restoration

VI. Education and Public Outreach

A. Local Meetings

In April 2000, about 25 citizens attended a meeting with County planning staff to discuss the comprehensive plan for the Finksburg area. WRPD used this opportunity to introduce the WRAS project, watershed concepts, and the need to protect drinking water through watershed

protection and restoration efforts. Citizens seemed interested in the outcome of this project and concerned about the drinking water quality. In anticipation of the update to the comprehensive plan update for the Finksburg area and prior to this project, surveys were distributed to Finksburg area citizens asking them to prioritize their concerns. County staff received many responses that indicated protecting drinking water quality should be a high priority.

B. SCA educational opportunities

During the study period, the three SCAs provided the most opportunities for public education and outreach. Each part of the SCA provided avenues to inform landowners of watershed concepts. As discussed earlier, obtaining permission from landowners to survey streams on their property provided many opportunities to reinforce the connection between land use activities and drinking water quality. WRPD reminded those citizens how important the public is to the success of the protecting drinking water quality of Liberty Reservoir. After the SCAs were completed, thank you notes were distributed informing landowners of the great cooperation the County received. Additionally, many landowners requested results of the SCA and the final report.

C. Information Brochure

An information brochure was also created as another means of public outreach. The brochure titled, “Watershed Assessments: Coming to a Watershed Near You” was created with the help of the County’s Communication Office. This product is planned to be available on the Internet. The purpose of the brochure was also to educate the public about watershed concepts and the Stream Corridor Assessment method. In the future, it will be distributed along with permission cards when subsequent watersheds are assessed via the SCA method. It will help alleviate concerns that landowners may have about this process.

The front cover of the brochure defines a watershed and introduces the watershed concepts of runoff, stormwater management, and point and non-point source pollution. The center section contains a county map showing all of the smaller watershed boundaries. It prompts the reader to discover in which watershed they reside. It also shows that streams within their home watershed eventually drain to distant water resources such as Liberty Reservoir. The back cover describes the SCA method and provides information showing prior success in the three subwatersheds already assessed. It also briefly discusses the stream impairments observed during the assessments within those subwatersheds. A copy of the brochure is located in the back of this report.

VII. Action Strategies

A. Introduction to Action Strategies

From the watershed assessment and evaluation process, WRPD identified opportunities to address likely causes of stream impairments. The list of action strategies introduced here is a plan to implement the opportunities available for restoration and protection of impaired natural resources. The strategies proposed are reasonable goals for action considering the current staffing and fiscal constraints within Carroll County Government. Much work can be accomplished by simply partnering with other local, state, and Federal agencies (as was done

during this grant period). Areas targeted for restoration or protection will be given to partner agencies to focus and coordinate the implementation with existing programs.

Additional project implementation beyond the coordination efforts described here present many challenges. In order to implement new projects, support will be required from the Board of County Commissioners and cooperation is needed among county departments with corresponding time and funding commitments. ***This planning phase just completed for a portion of the Liberty Reservoir watershed was relatively inexpensive; the next phase, implementation, will be much more costly.*** To assist with the implementation of watershed activities, the county will consider the technical and financial resources provided by DNR. DNR staff can provide assistance with stream buffer plantings, water quality data collection, and wetland enhancement and creation. Financial assistance (e.g., EPA's 319 grant funding mechanism) may help to make more costly but necessary projects feasible.

1. Nutrient Source Tracking Strategy

The goal of this strategy is to investigate sources of nutrients within the Liberty Reservoir Watershed. WRPD selected the further study category for several subwatersheds in both Middle and Snowdens Run. In many instances more detailed nutrient loading information is needed to help target areas for restoration or protection activities. Part of the additional investigation will involve collecting additional water quality data with their associated stream flows at incremental steps upstream in the watershed. As the subwatersheds being monitored become smaller, it may be possible to identify the actual sources of the elevated nutrient loadings. Before such a strategy is fully implemented, nutrient criteria will be needed to place the resulting nutrient loadings in context in order to determine if the loading estimates calculated are in fact an issue of concern; however, both the City of Baltimore and Baltimore County Department of Environmental Protection and Resource Management share an interest to track higher nutrient loads closer to their sources. Staff from these organizations will meet in the spring of 2003 to discuss development and implementation of this strategy.

2. Agriculture BMP Targeting Strategy

The goal of this strategy is to focus existing efforts by the Carroll County SCD within the Liberty Reservoir Watershed to smaller subwatersheds deemed a high priority for restoration. Currently, one SCD employee is dedicated to work cooperatively with farmers to implement BMPs within the entire Liberty Reservoir Watershed. Dedicating an employee to work in the Liberty Reservoir Watershed was a result of the Reservoir Watershed Management Agreement. Because of the large size of the entire watershed and the limited resources available, the SCD wished to identify a method to focus their efforts. The SCD will be able to examine recently developed maps of BMP locations to determine if further work needs to be accomplished in the targeted subwatershed.

3. Stormwater Retrofit and Storm Drain Repair Strategy

The goal of this strategy is to retrofit SWM facilities and repair storm drains contributing to water quality degradation. WRPD staff met with the Bureau Chief of Road Operations and the County's Stormwater Management Engineer to present the information gathered throughout the course of the WRAS. Maps were presented relating SCA impairments with storm drains pipe

outlets and SWM facilities. As discussed previously, this combination of information revealed a likely cause and effect relationship between untreated stormwater and stream bank erosion. Older SWM facilities without the most recent technological updates were also discussed as another possible opportunity for restoration activities.

On its own, the Bureau of Road Operations uses citizen complaints to help prioritize the repair work that they do. After some discussion, it was agreed that Water Resources staff should provide the Bureau of Road Operations with maps of the selected subwatersheds chosen as top restoration priorities within Middle and Snowden's Run watersheds. The Bureau will then mark areas where they have received citizen complaints about the condition of storm drains or outfalls that are causing problems on their property or in their neighborhood. By meshing the priorities of both agencies and the reported community concerns, Carroll County hopes to address several goals with each project selected. Rather than just accomplish a water resources objective, projects can be targeted to also satisfy citizen concerns, thus involving public and community priorities in the process. Several critical factors must be considered before projects are selected and implemented. These factors include funding availability, property ownership and permission, site accessibility, and surrounding infrastructure. Operating budgets for the Bureau of Roads Operations will have to be evaluated to determine if any adjustments are needed to fully implement this strategy. Some of the work may be beyond the current capabilities that the Bureau of Road Operations, and in those cases work will have to be contracted out, unless performed by a developer in lieu of on-site storm water management. Considering all of these factors, projects will be selected on a site-by-site basis.

Another aspect to addressing stormwater issues is retrofitting storm drains within the highest priority areas for restoration. Under the 2000 Maryland Stormwater Regulations, stormwater credits are available to correct existing problems in lieu of providing stormwater management for new development. Again, maps of Water Resource Planning's high priority subwatersheds for restoration will be provided to the Division of Stormwater Management. As new development occurs within the watershed, attempts will be made to direct the designers and engineers toward *retrofitting* existing storm drains within the areas of concern. ***Stormwater retrofits are project opportunities where SWM can be added to land previously developed without it.*** This proposal also requires additional considerations, such as the need to identify county owned lands adjacent to areas where the retrofitting will occur, public anxiety regarding the West Nile virus and standing water, high expense, and the sometimes large area of land necessary to implement storm water retrofits. ..

To credibly address a large issue like improved storm water management will take the commitment and resources of several agencies, and in some cases community participation and cooperation. It is the intention of WRPD to build and maintain the necessary partnerships with the Bureau of Road Operations and Division of Stormwater Management to help address areas where stormwater runoff is contributing to impairments within the stream system.

4. Stream Buffer Planting Strategy

The goal of this strategy is to coordinate with appropriate partner agencies to establish stream buffers. Upon completion of the evaluation process, Carroll County will continue to cooperate with two of the WRAS partners, the Carroll County Soil Conservation District and the Friends of Carroll County Streams (FOCCS), to provide them with targeted subwatersheds to focus their efforts and look for opportunities to plant stream buffers. WRPD will choose areas based upon the severity and extent of the results from the SCA inadequate buffer impairments.

Also, with the implementation of the Nutrient Tracking strategy and the existing nutrient data, subwatersheds will be prioritized based upon high nutrient load estimates. One goal of this cooperation is to target limited resources and funding where the buffers will provide the most benefits. Most likely, the SCD focus their planting efforts within the Middle Run watershed since very few acres in agricultural production remain in the Snowden's Run area. If a forest buffer is not desirable for the landowner, then a grassed buffer may be suitable in the agricultural areas of the county while still providing filtering benefits of a well-managed buffer. To reduce duplication of effort and take advantage of established agriculture stream buffer planting programs, Carroll County should provide the FOCCS subwatersheds that target primarily non-agricultural areas of the county. An initial step of this strategy will be to contact landowners with a lack of buffered stream corridors on their property to determine their willingness to cooperate.

5. Database Update Strategy

The goal of this strategy is to periodically update important databases necessary for future watershed assessments. Databases related to the watershed assessment and prioritization process are used to 1) monitor the progress of the implementation of BMPs, 2) determine the status of the number and types of protective measures (e.g., conservation easements) implemented, and 3) show up-to-date possible causes of degradation to the resource. As stated previously, updating recently created and existing databases with new information is crucial to the success of future watershed assessments and evaluations. WRPD plans to meet with staff from the SCD and annually update the data layers containing BMP locations on agricultural land. In addition, WRPD plans to semi-annually update the database of Water Resource Protection Easements.

6. Establish Watershed Advisory Committees

The goal of this strategy is to create small groups within the Liberty Reservoir Watershed to implement projects that reflect the goals of the Action Strategies described in this report. The idea for this strategy originated from Westchester County, NY. Westchester County formed small groups called watershed action committees (WACs) to implement projects within watersheds previously assessed and prioritized. The purpose of the WACs is to implement previously agreed upon steps to improve nitrogen loads to Long Island Sound. For additional information on their efforts visit their web site at <http://www.co.westchester.ny.us/planning/environmental/environ.html>.

All implementation plans developed by the WACs include four major components:

- 1) An evaluation of the effectiveness of SWM facilities within the selected watershed
- 2) An assessment and evaluation of natural resources with recommended actions needed for restoration and protection (i.e., what was just completed for this WRAS)
- 3) A list of recommendations to local ordinances and the comprehensive plans incorporating water quality improvements
- 4) Outreach and education effort directed to municipal officials, staff, and the public

The oversight group for this effort is the Westchester County Committee on Non-Point Source Pollution. A similar framework and oversight group already exists within the Liberty Reservoir watershed: the Reservoir Technical Group. Furthermore, in Westchester County the

local Environmental Planning Section within the County Department of Planning provides staff support and technical expertise to support the WACs. Again, the WRPD already provides technical expertise in water resource related areas to municipalities within Carroll County, and could function in this capacity as well.

Similar to Westchester County, *the purpose of forming WACs within the Liberty Reservoir watershed would be to implement the action strategies developed during this WRAS and future watershed assessment and evaluations*. One possibility would be to form two watershed action committees within Liberty, with the emphasis on taking action and implementing projects; committees will be composed of technical staff from appropriate agencies needed to actually implement projects. Each WAC would be assigned a group of the major watersheds within Liberty. For instance, one committee would be responsible for watersheds north of Route 140, while the other committee would be assigned the remaining watersheds.

7. County Program Coordination Strategy

The goal of this strategy is to coordinate development review functions to improve natural resource protection. Recently the County Commissioners decided to reorganize several county agencies to reflect the renewed commitment to natural resource protection in Carroll County. With this reorganization, the environment/resource protection and the development review functions are now within the Department of Planning. Previously, these functions were located in three different departments making coordination and natural resource protection difficult. Now all of the resource protection aspects of the development review process (floodplain management, forest conservation, stormwater management, and water resource protection) are within the Bureau of Resource Management.

The review of development plans will be coordinated among the different ordinances and regulations to achieve the greatest level of resource protection possible. The full integration of the resource protection functions with the comprehensive planning function allows for closer coordination between the two groups on land use issues. Plans are in place to develop watershed management components to future comprehensive plans. This renewed partnership between planners and resource protection specialists will allow for more realistic land use goals and objectives.

B. Monitoring Success

Monitoring the condition of the watershed is a critical tool to measure the success of future watershed protection and restoration activities. Although it is unclear as to how many years to monitor before and after project implementation, it is evident that both are necessary to answer the question of project success. Water quality results from implementing the Nutrient Source Tracking Strategy may provide useful pre and post project monitoring information.

There are several additional sources of existing monitoring activities that will help to assess the effectiveness of future projects:

- Future watershed restoration or protection activities implemented in response to the County's National Pollution Discharge Elimination System permit also require monitoring to assess project effectiveness.

- DNR's MBSS program provides water quality information including biological, nutrient, temperature, and physical habitat data that may provide insight into the success of stream buffer plantings as well as agriculture and stormwater BMP effectiveness.
- Carroll County currently inspects over 400 SWM facilities. Closely monitoring their need for repair and update will greatly increase their utility.
- Ultimately, the City of Baltimore's on-going reservoir monitoring program will indicate if watershed protection and restoration activities improve the water quality within the reservoir itself.

VIII. Next Steps

- By the early summer of 2003, WRPD will initiate efforts to organize and begin the Watershed Advisory Committee process. WRAS partners will be invited to meet and develop procedures for implementing the above strategies. Maps of targeted, high priority subwatersheds will be distributed enabling WAC members to focus in those areas of most concern to their function. Figure 15 is an example of the type of map to be distributed to the Bureau of Roads Operation and the County's stormwater engineer to begin to look for opportunities to implement strategy 2 (SWM retrofit/Storm Drain Repair) within the Middle Run Watershed. Based on the previous evaluation, most of the impacts within Middle Run related to stormwater management are occurring in subwatersheds 103 and 104; consequently, these areas have been selected as initial target areas to implement that particular strategy. Also, criteria will be developed for reporting and tracking progress toward restoration efforts. Regular meetings will be scheduled to report progress and review implementation efforts.
- During the spring of 2003, WRPD will meet with the City of Baltimore, Water Quality Section to establish and coordinate a nutrient tracking procedure. Preliminary discussions have indicated a mutual desire to undertake this effort. The targeting process developed from the WRAS will enable the County and the City to focus their limited resources to those subwatersheds with the greatest relative nutrient levels. By further focusing on the source area(s) for nutrients, either point or non-point sources, mitigation measures can be realistically planned.
- The process developed through the WRAS grant is directly applicable to the County's National Pollution Discharge Elimination System (NPDES) permit objectives. Planning is already underway to apply the methods and procedures developed and tested through the WRAS to an additional watershed. That watershed is being assessed as part of the requirements for compliance with County's NPDES permit.

Liberty Reservoir Watershed Restoration Action Strategy

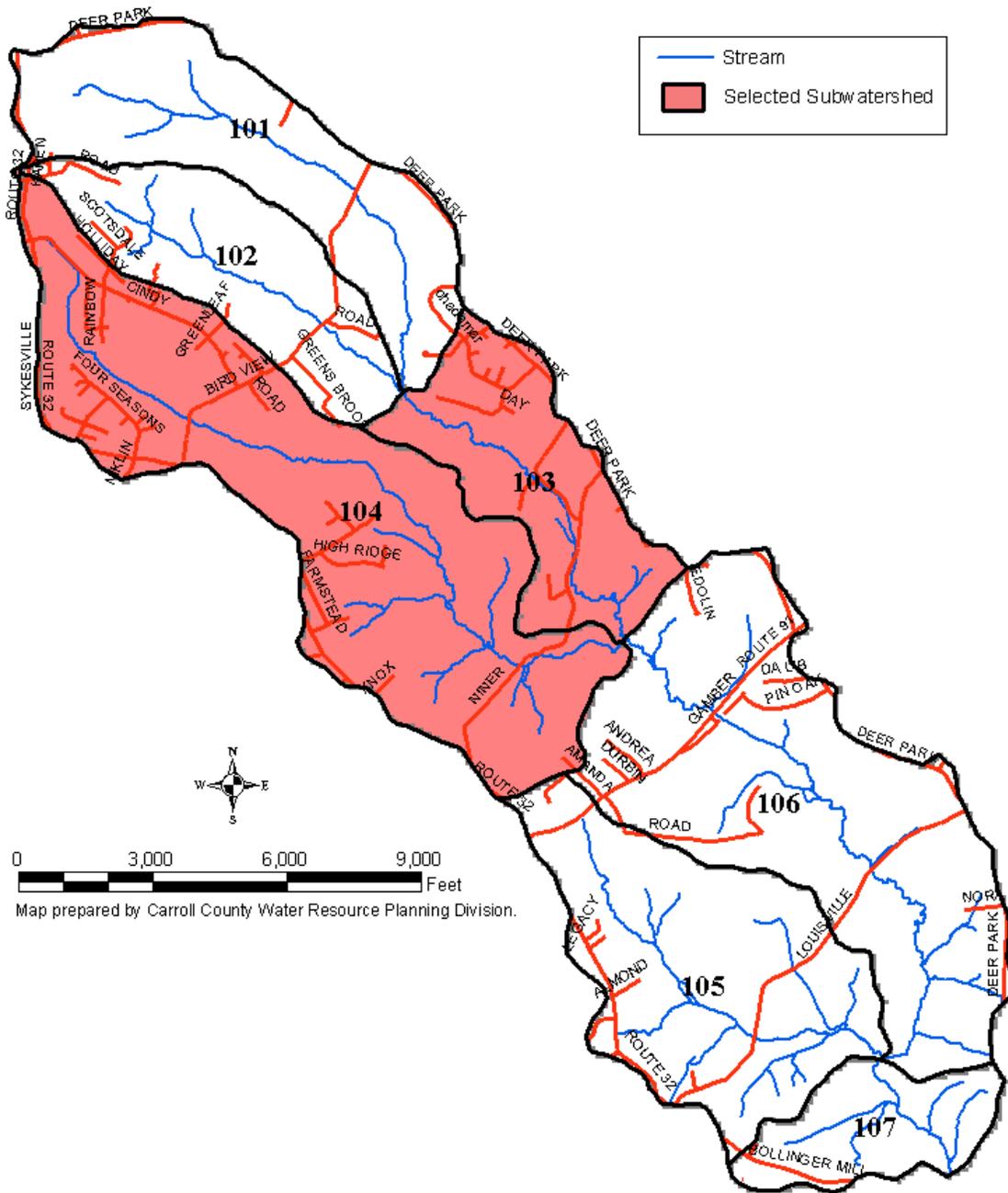


Figure 15. Selected Subwatersheds within Middle Run to Implement Stormwater Retrofit/Storm Drain Repair Strategy

IX. References

Baltimore Metropolitan Council, 2000. 2000 Action Report for The Reservoir Watersheds.

Clean Water Action Plan Technical Workgroup. Maryland Clean Water Action Plan. December 1998. www.dnr.state.md.us/cwap/

Covington, Martin. 2003. Carroll County Stormwater Engineer. Personal Communication.

Czwartacki, S. and K. Yetman. Liberty Reservoir Stream Corridor Assessment Survey. DNR, Chesapeake and Coastal Watershed Services, Watershed Restoration Division. October, 2002

McCoy, John. April, 2000. A Stream Corridor Assessment for Cranberry Branch, Maryland Department of Natural Resources, Chesapeake and Coastal Watershed Services, Watershed Restoration Division.

Primrose, N. April 2002. Report on Nutrient and Biological Synoptic Surveys in Portions of the Carroll County Drainage to Liberty Reservoir. Maryland Department of Natural Resources, Chesapeake and Coastal Watershed Services, Watershed Restoration Division, Watershed Evaluation Section.

Shanks, K. Liberty Reservoir Watershed Characterization. DNR, Chesapeake and Coastal Watershed Services, Watershed Management and Analysis Division. September 2002.

Stranko, S., J. Killian, A. Prochaska. September 2001. Final Data Report: Assessment and prioritization of Coastal Zone Management area streams in need of restoration and protection including an analysis of potential impact sources. Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division.

Watersheds Professional Network, 1999. Oregon Watershed Assessment Manual. June 1999. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon.

Westchester County, New York, Non-Point Source Pollution Control Program in Leadership in Watershed Management: The County Role. June, 1999. A Report of the National Association of Counties' Watershed Management Advisory Committee. National Association of Counties (NACO). .

Yetman, Kenneth T. Stream Corridor Assessment Survey, SCA Survey Protocols. Maryland Department of Natural Resources, Chesapeake and Coastal Watershed Services, Watershed Restoration Division. September 2001.